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(12) **United States Patent**
Kawaguchi

(10) **Patent No.: US 7,632,029 B2**
(45) **Date of Patent: Dec. 15, 2009**

(54) **RECORDING APPARATUS**

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(73) Assignee: **Canon Kabushiki Kaisha**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 989 days.

(21) Appl. No.: **10/914,264**

(22) Filed: **Aug. 10, 2004**

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US 2005/0041054 A1 Feb. 24, 2005

(30) **Foreign Application Priority Data**

Aug. 20, 2003 (JP) 2003-296195

(51) **Int. Cl.**
B41J 3/407 (2006.01)

(52) **U.S. Cl.** **400/59**; 400/56; 400/61; 720/606; 720/601

(58) **Field of Classification Search** 455/556.1, 455/557, 550.1, 90.3, 575.1, 575.8; 101/128.21, 101/35, 129, 41, 486, 21; 400/61, 582, 59, 400/55, 56, 521, 541; 355/69; 720/606, 720/601; 347/104, 101, 8, 19
See application file for complete search history.

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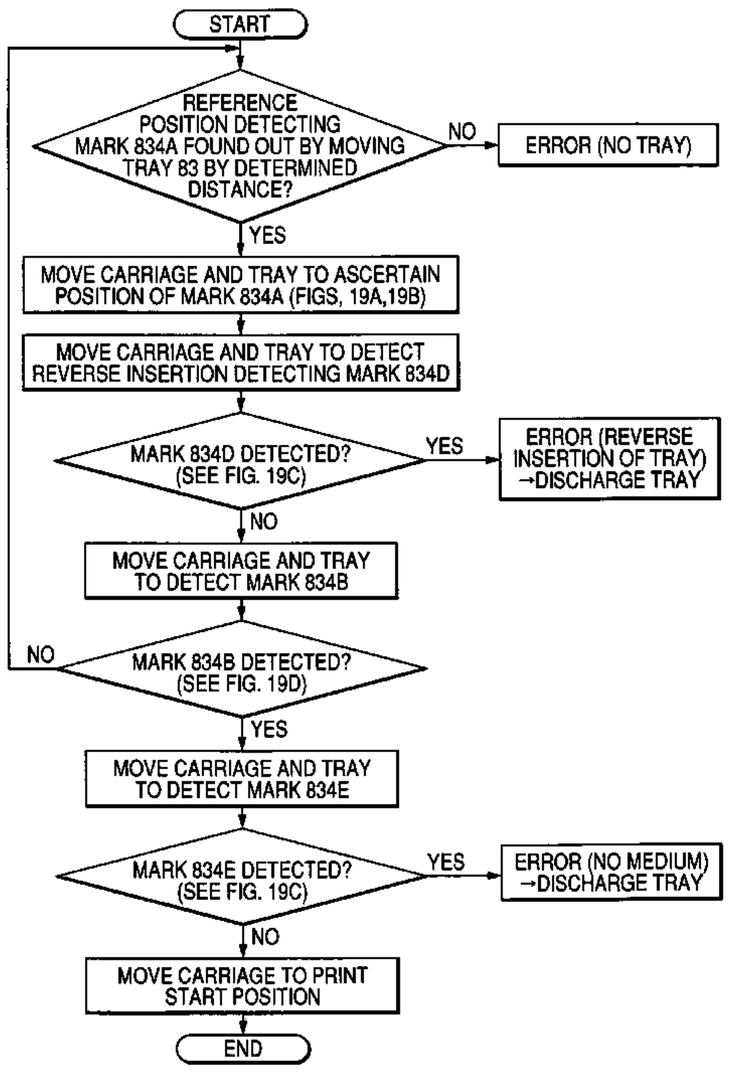
Primary Examiner—John Lee
(74) *Attorney, Agent, or Firm*—Fitzpatrick, Cella, Harper & Scinto

(57) **ABSTRACT**

Disclosed is a recording apparatus that can accurately detect the position of a recording member, such as thick paper or a CD-R, that is mounted on a tray, that can, as much as possible, protect to-be-detected portions from being scratched, and that can perform accurate printing using a simple structure.

With a configuration wherein a recording member such as thick paper or a CD-R is mounted on a tray, and wherein the recording member is printed while the tray is conveyed, a reference position detection mark, which is a to-be-detected portion, is attached to the tray from the reverse face, and the edges of a reference position detection mark that has been detected are made as the edges of a hole portion that is formed in the tray.

7 Claims, 24 Drawing Sheets



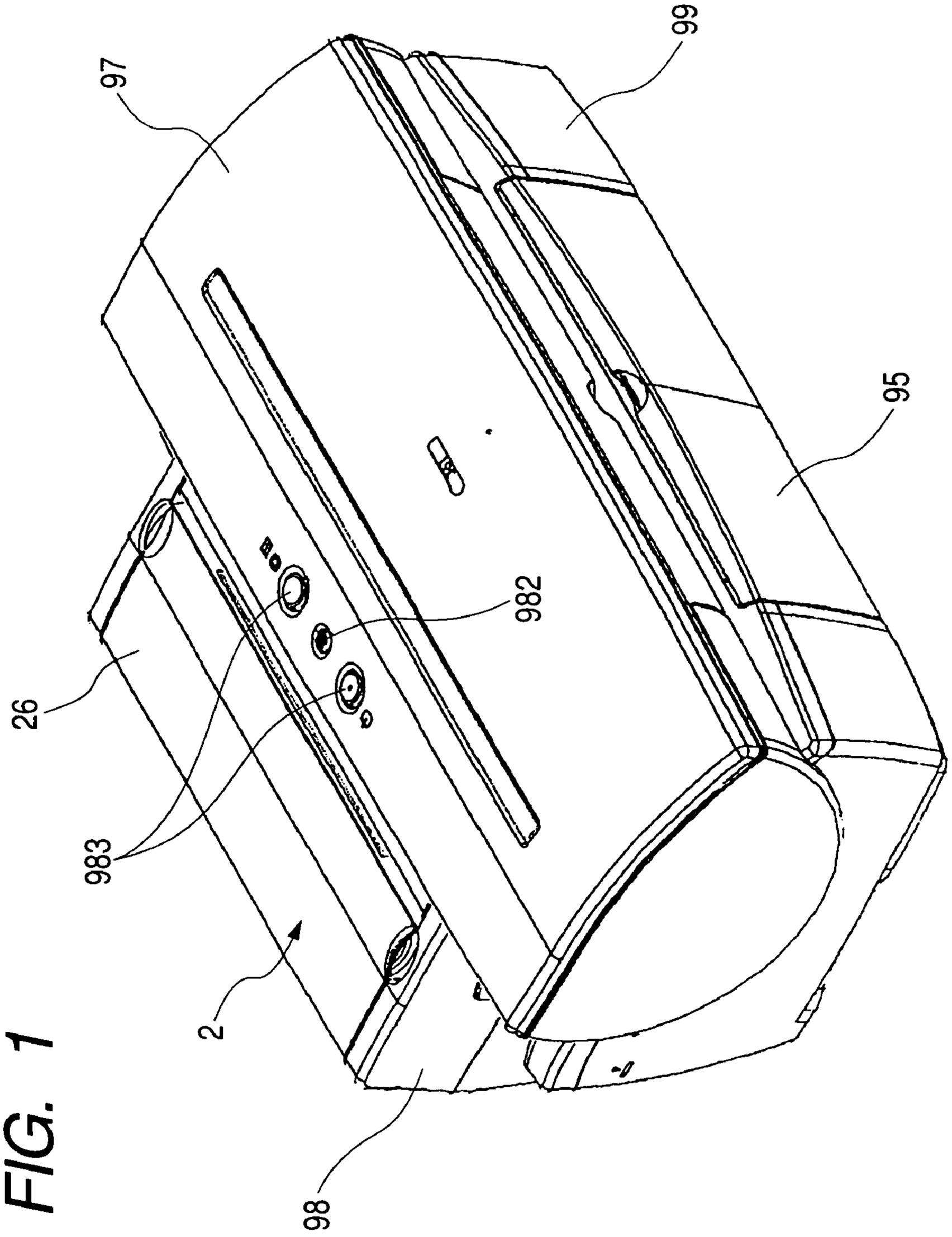
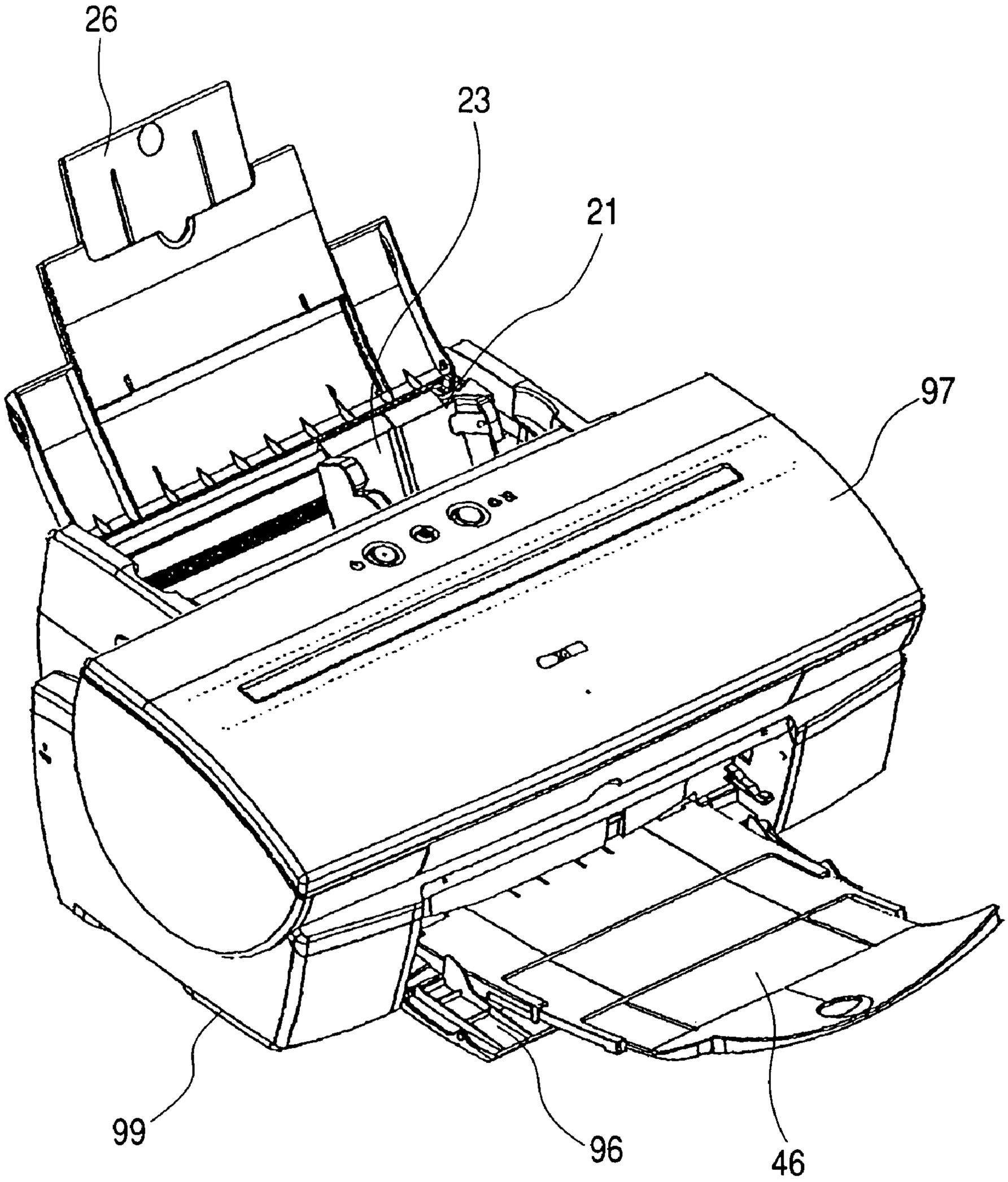


FIG. 1

FIG. 2



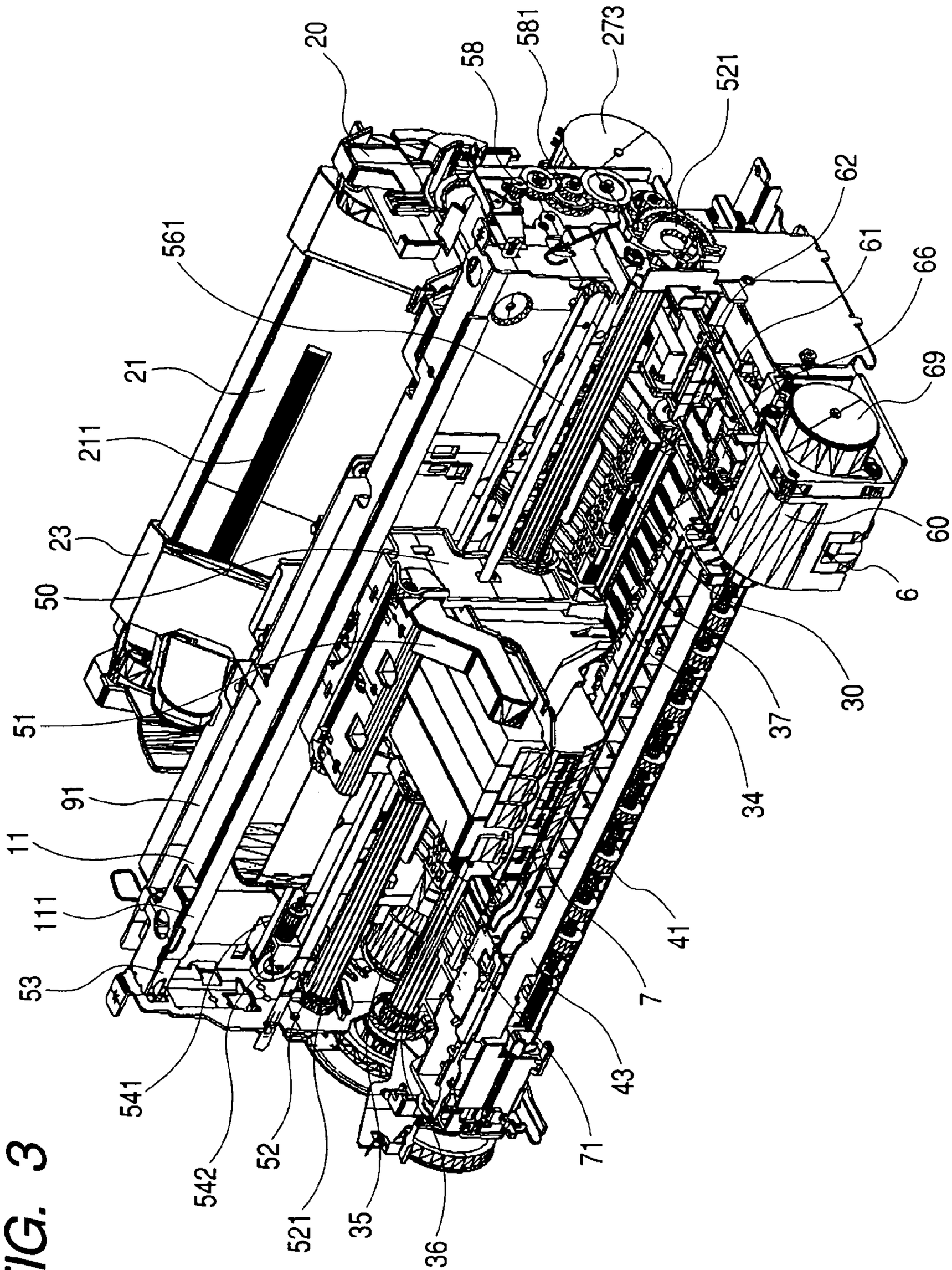

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FIG. 3

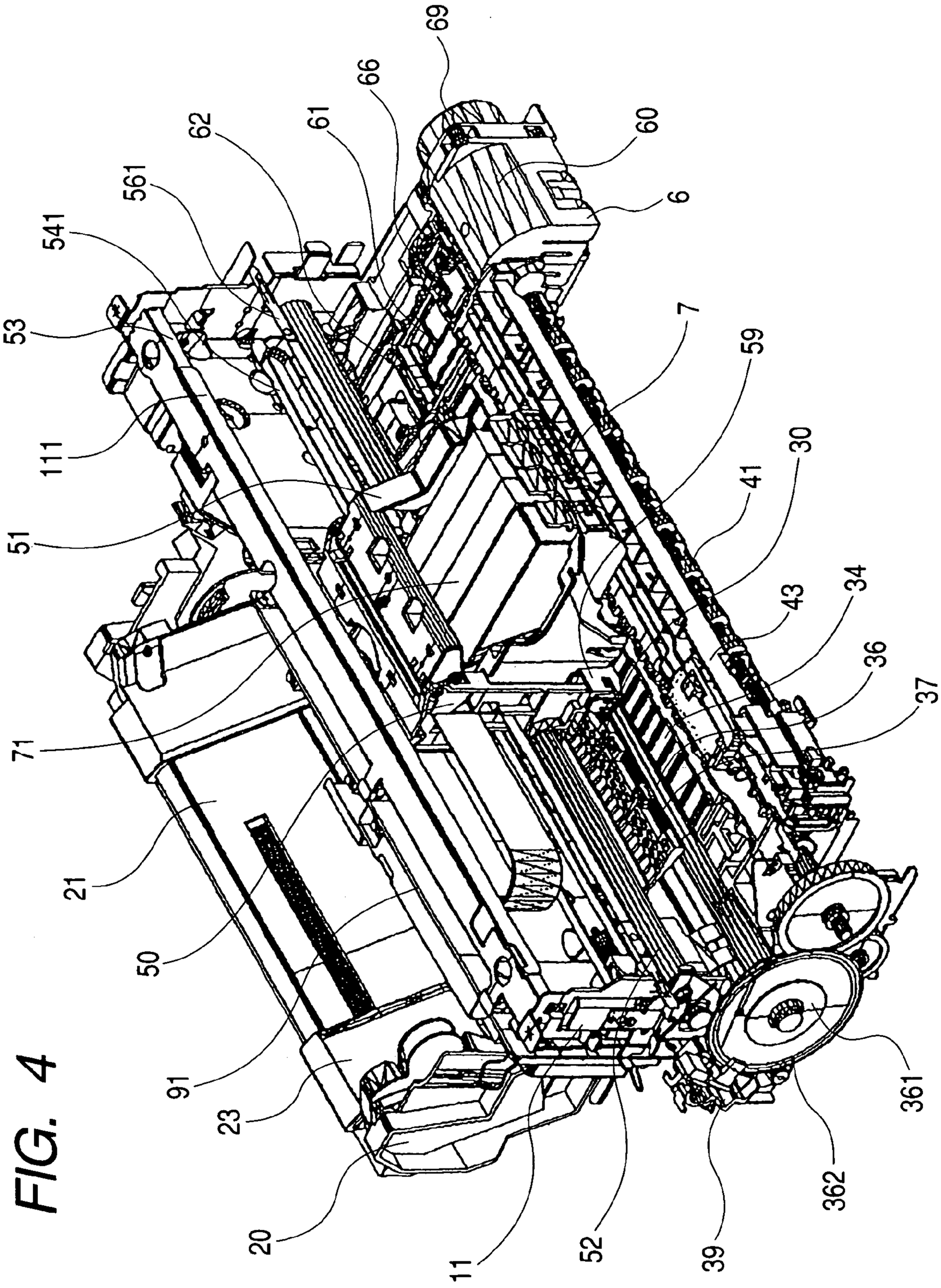
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FIG. 4

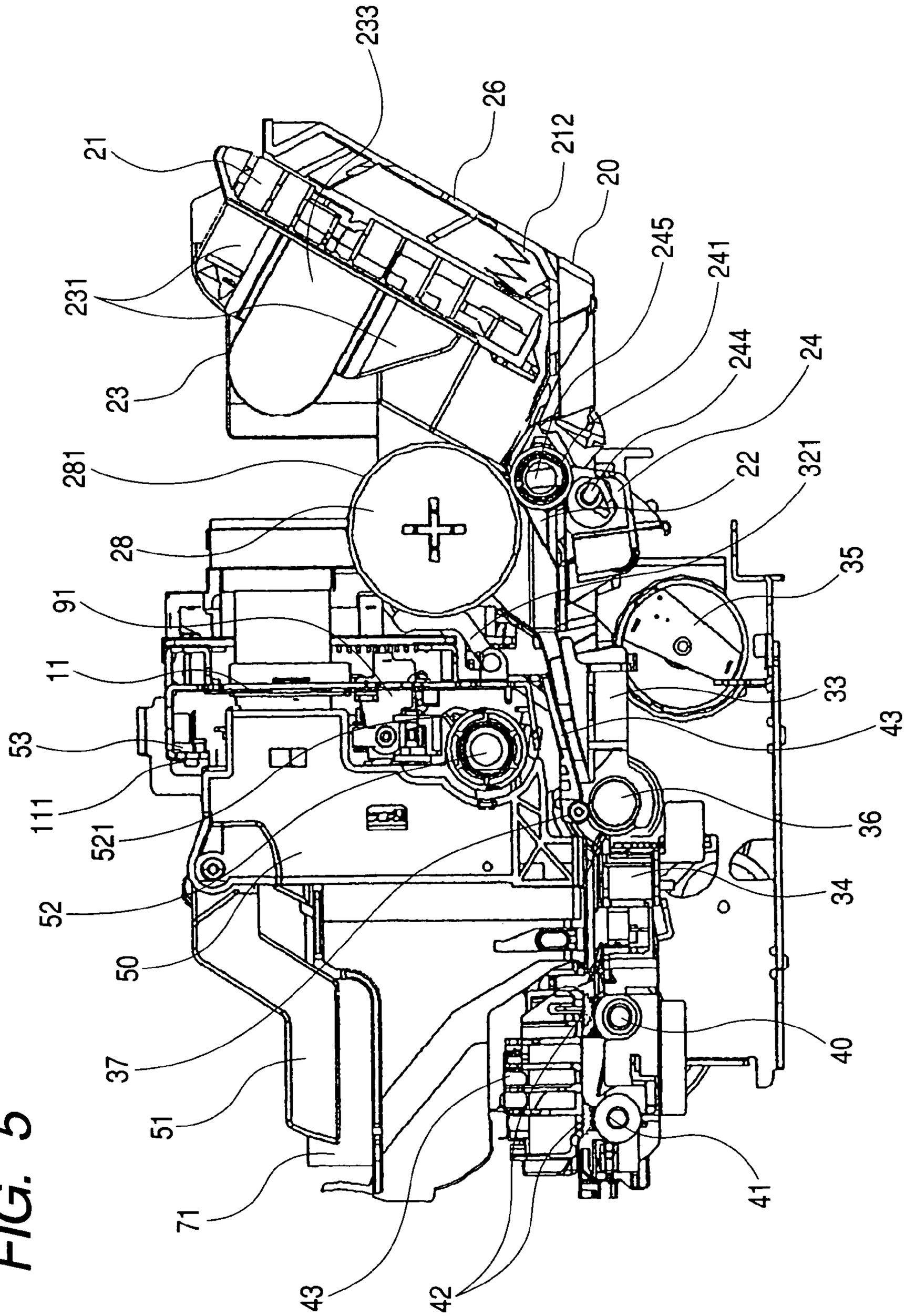
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FIG. 5

FIG. 6A

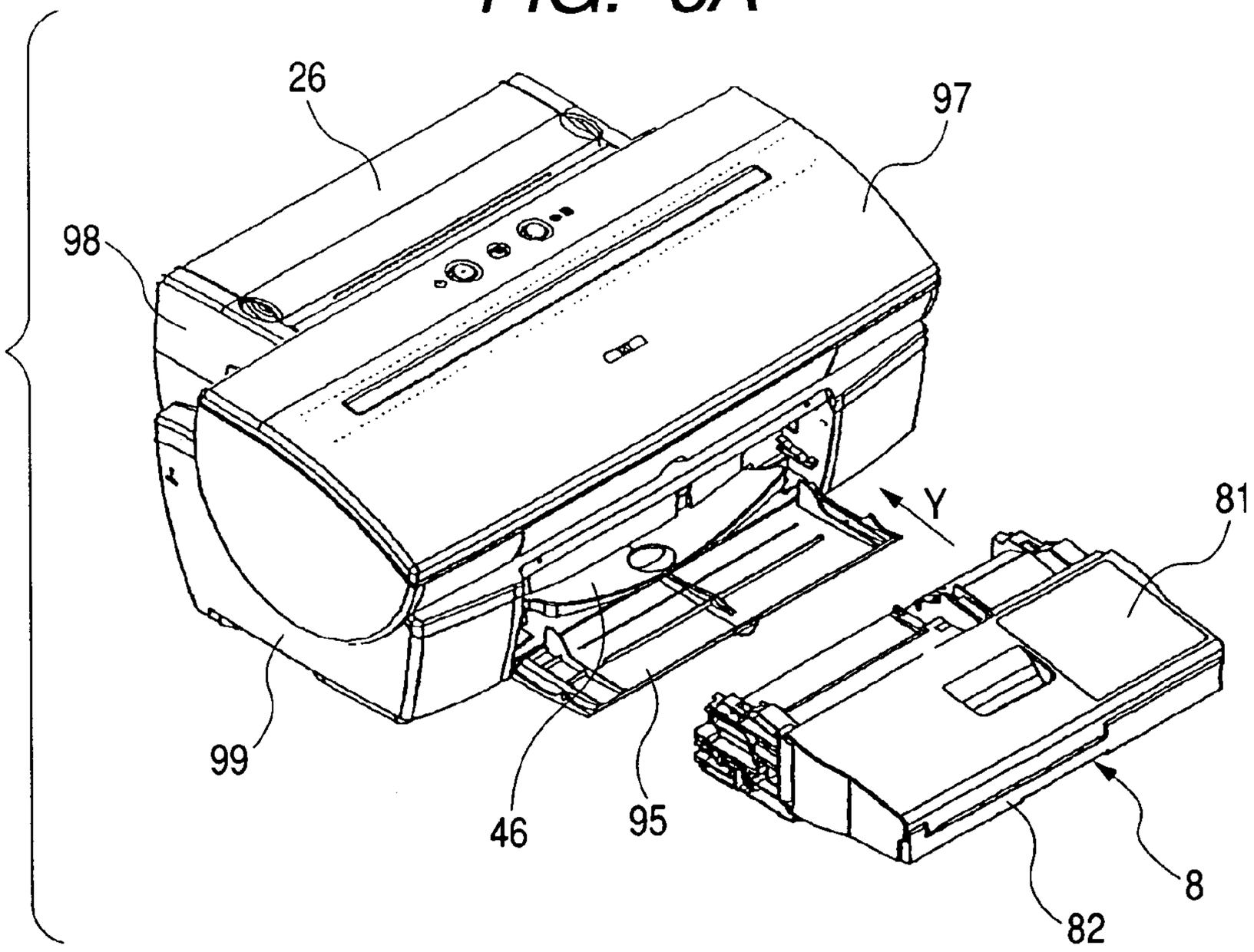


FIG. 6B

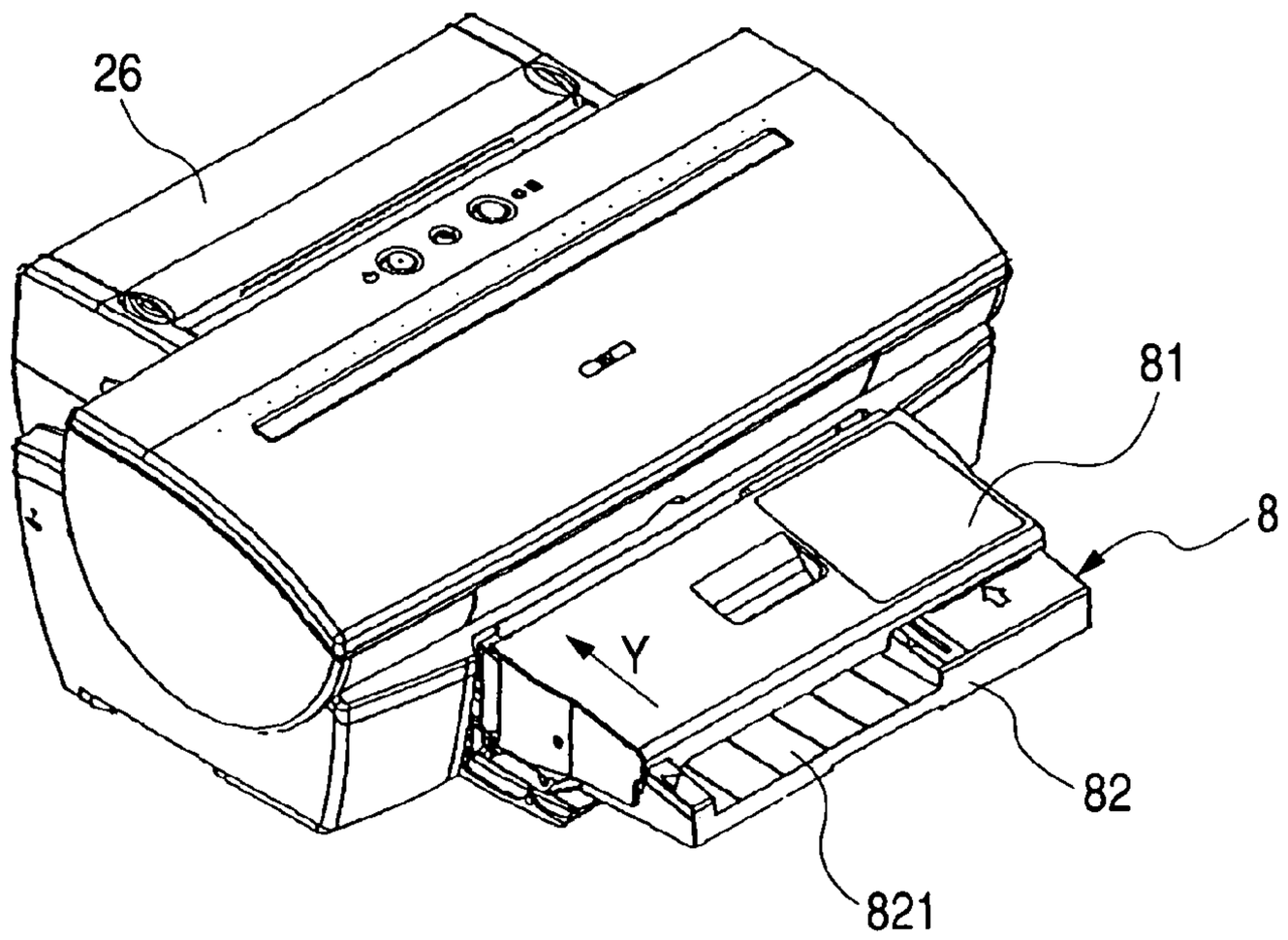


FIG. 7

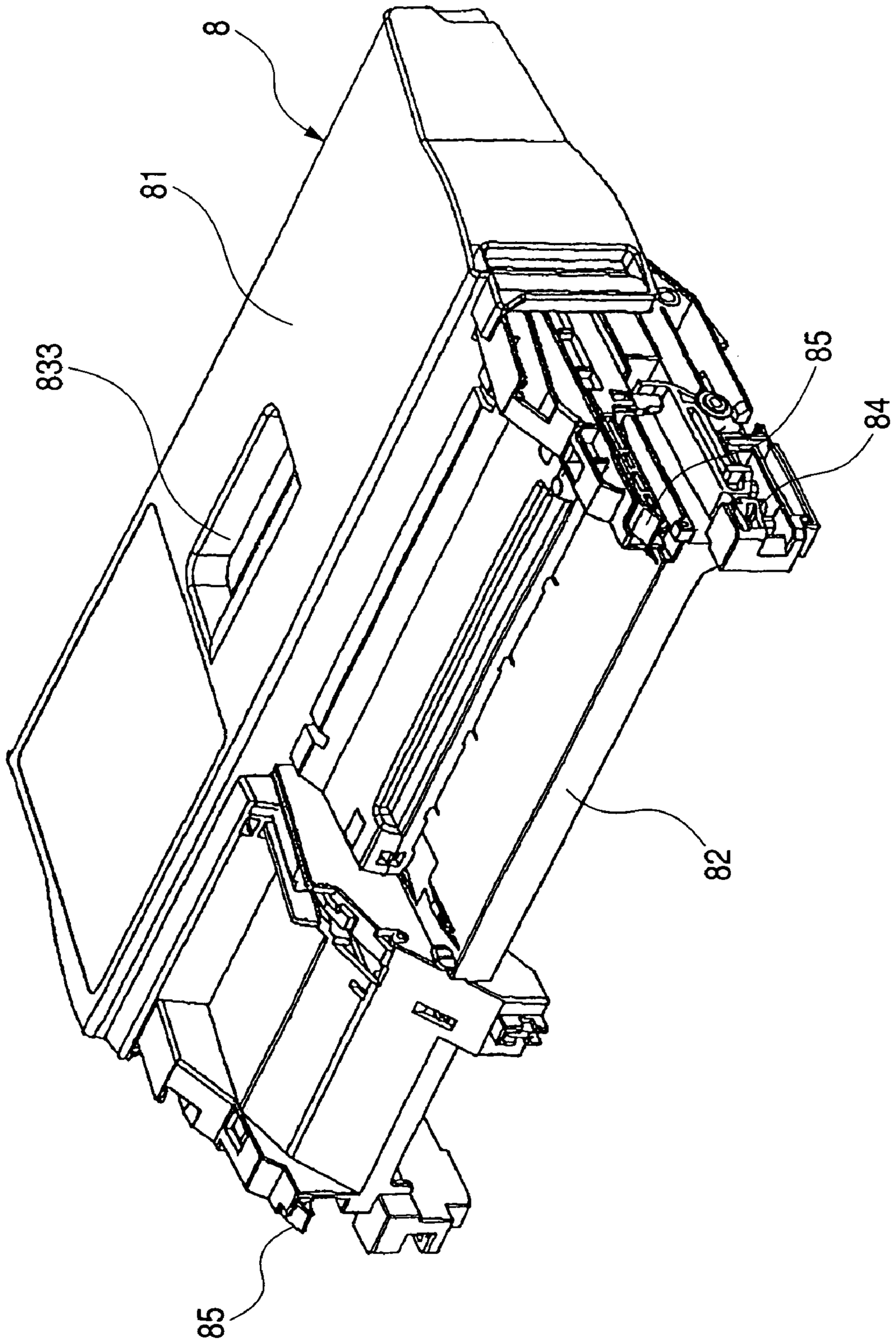


FIG. 8

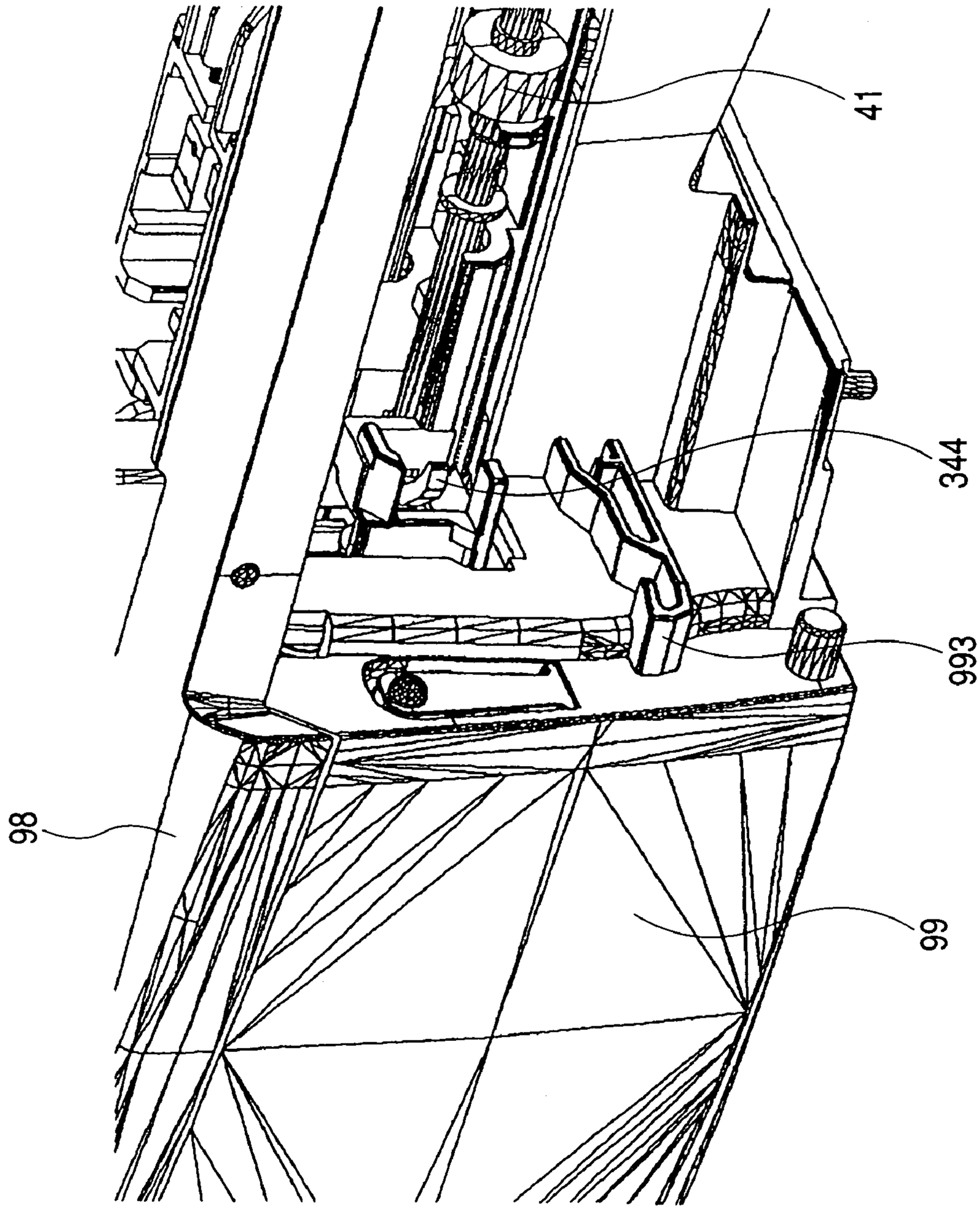


FIG. 9

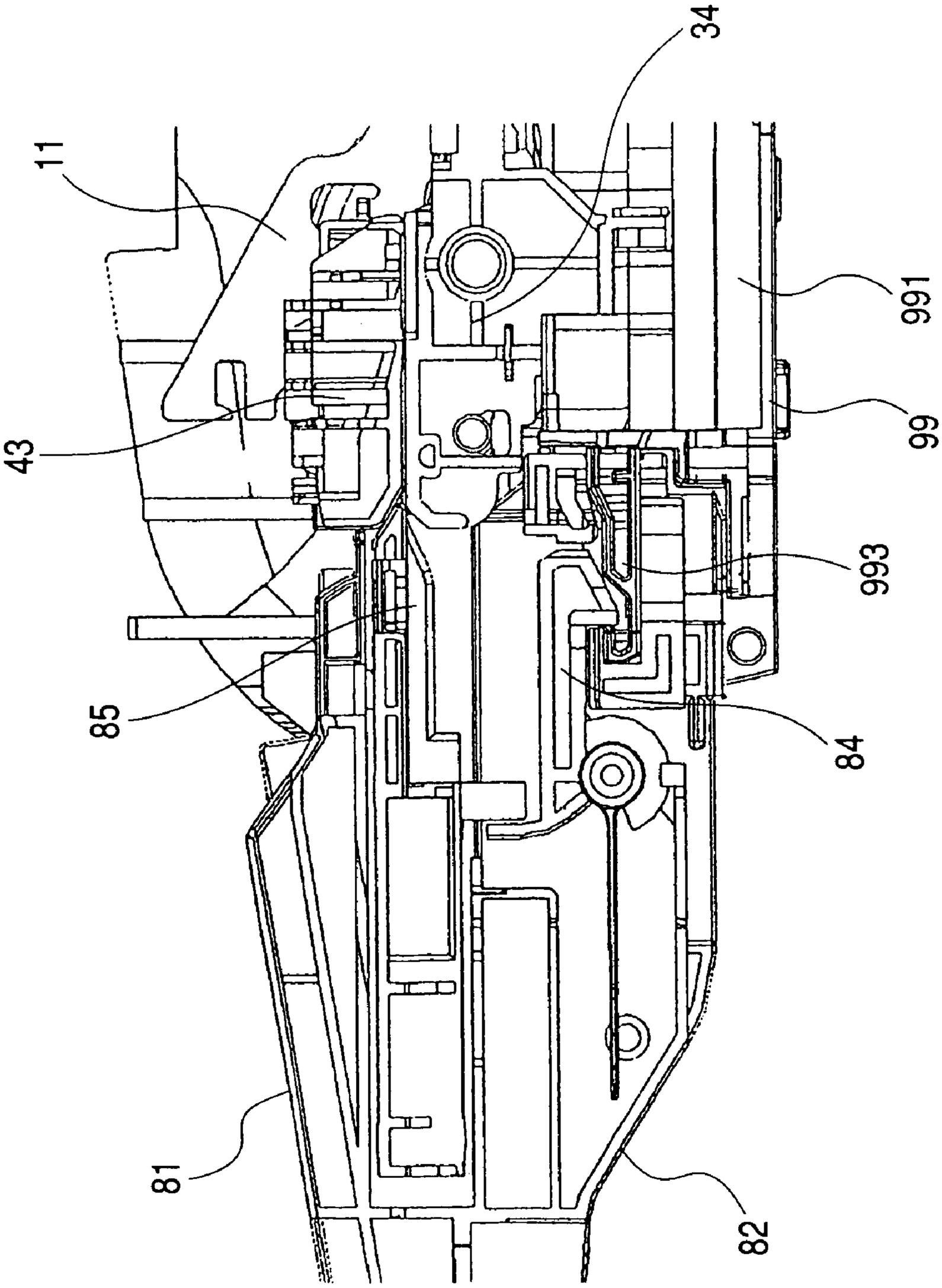


FIG. 10A

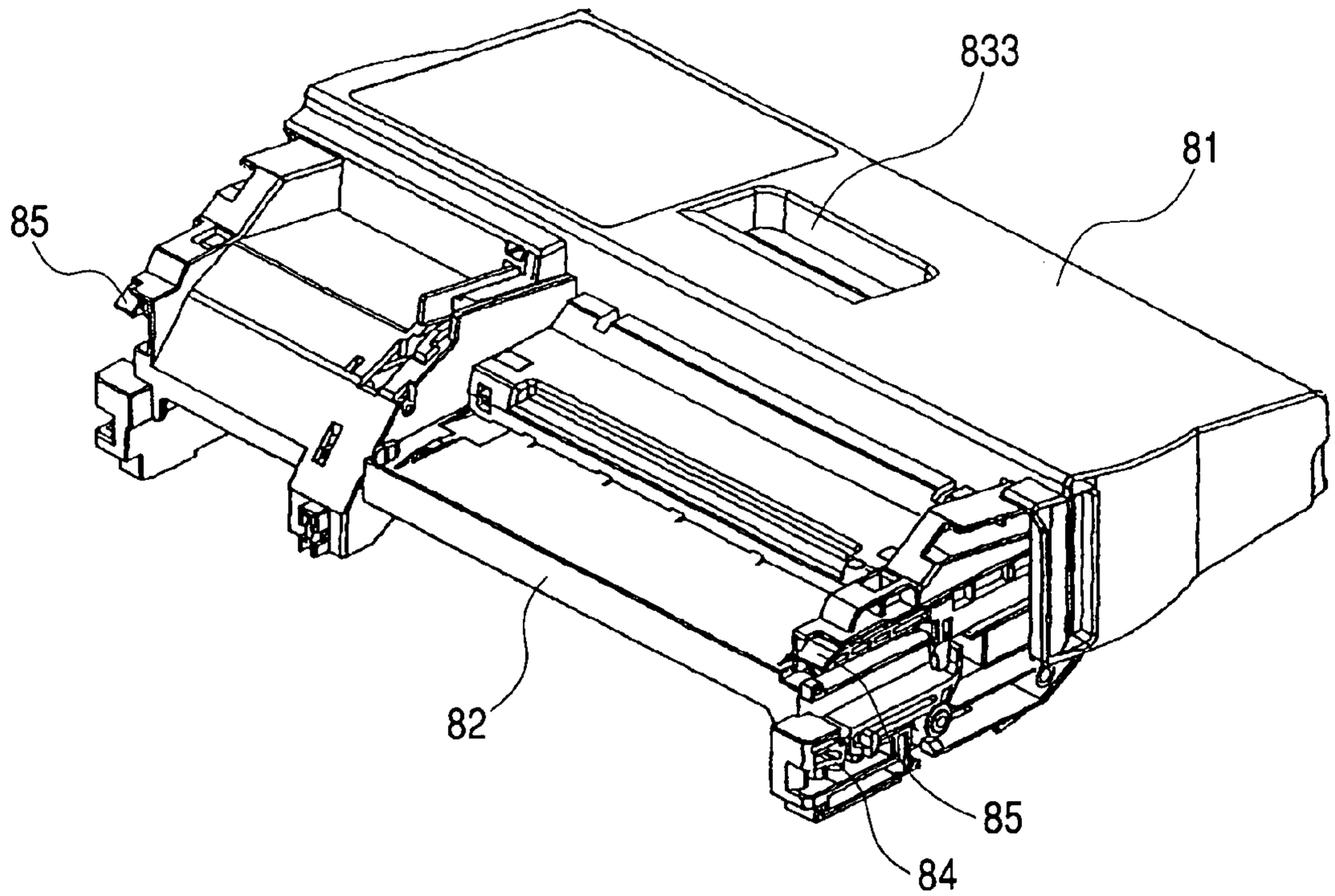


FIG. 10B

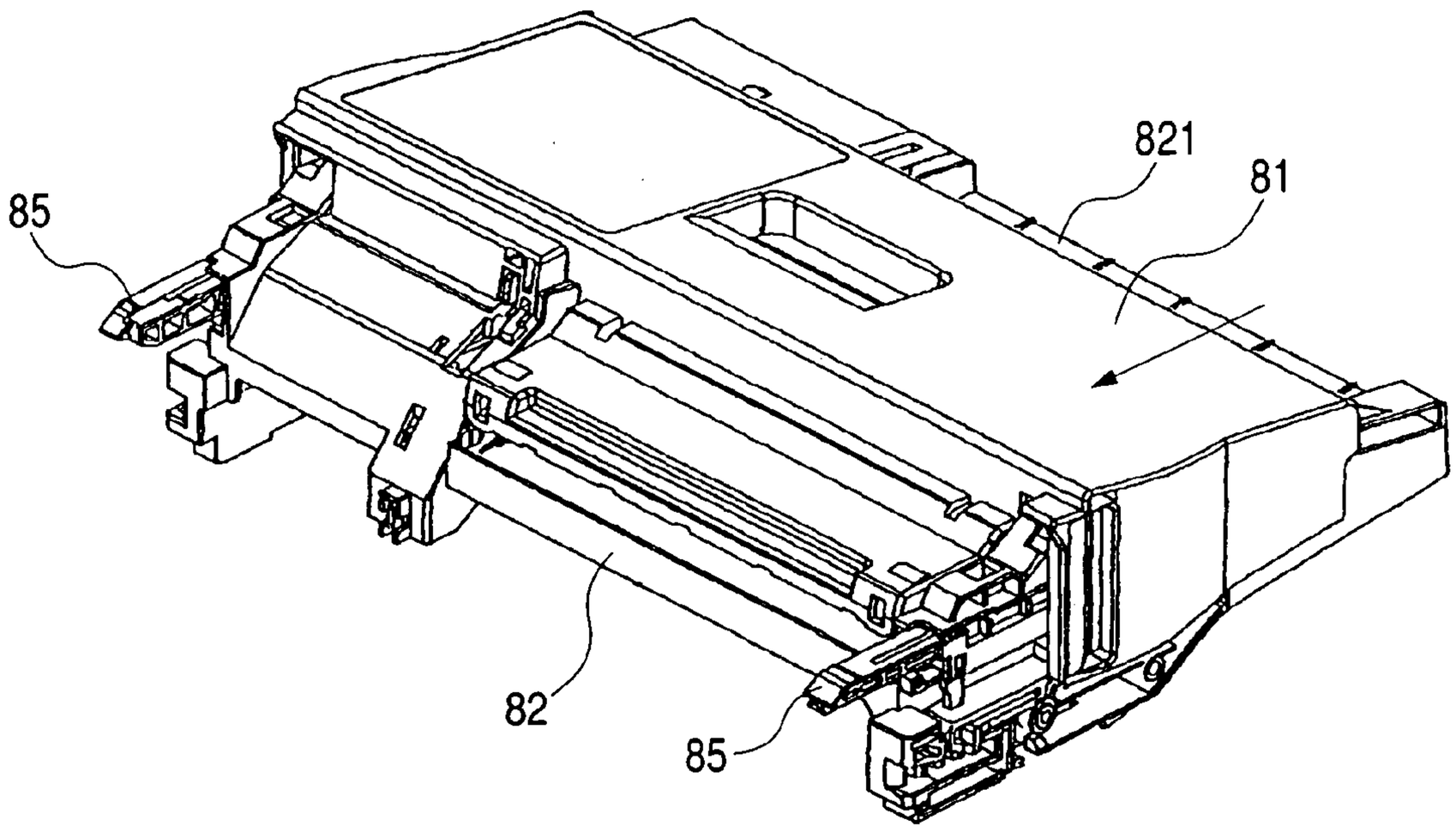


FIG. 11

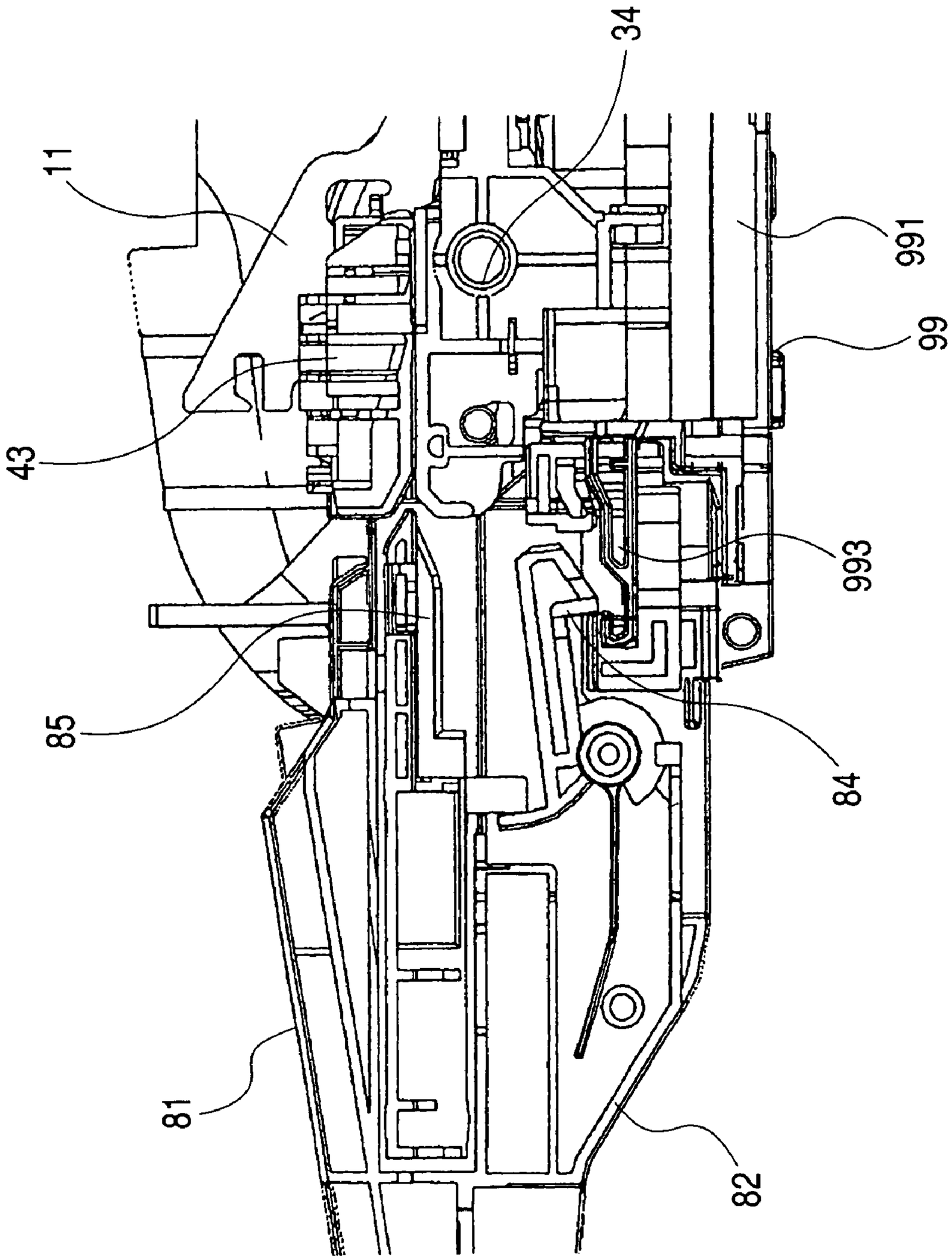


FIG. 12A

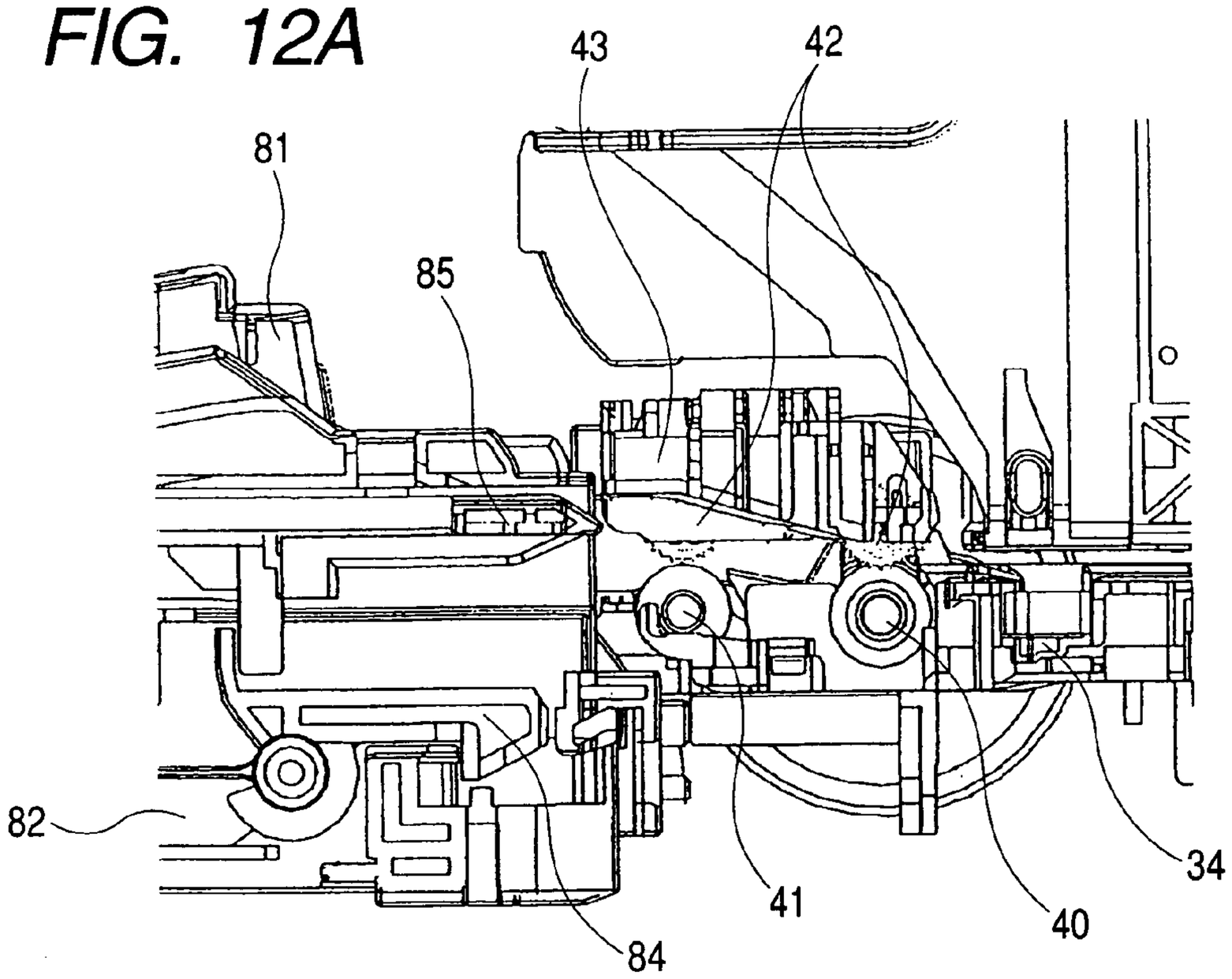


FIG. 12B

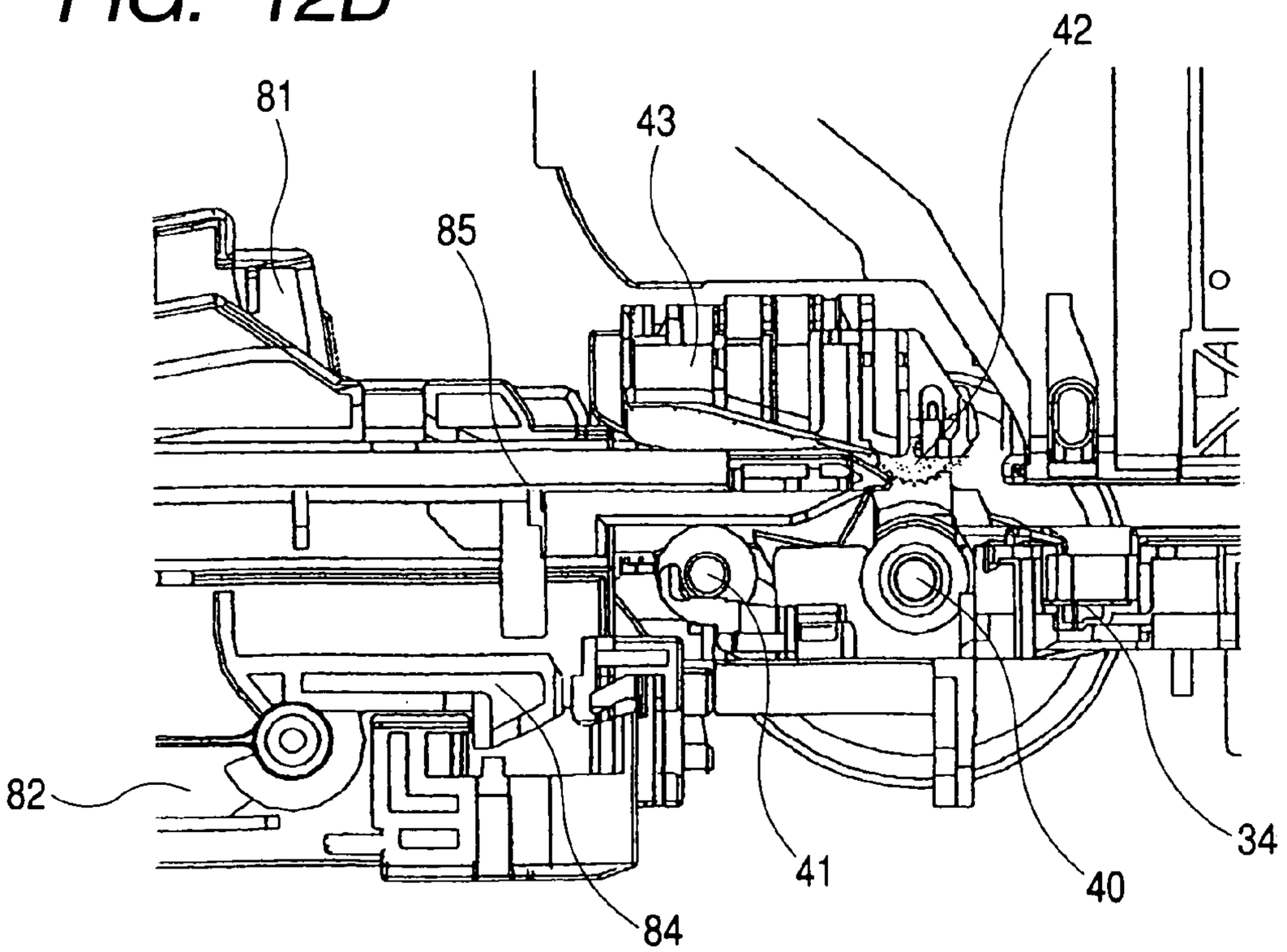
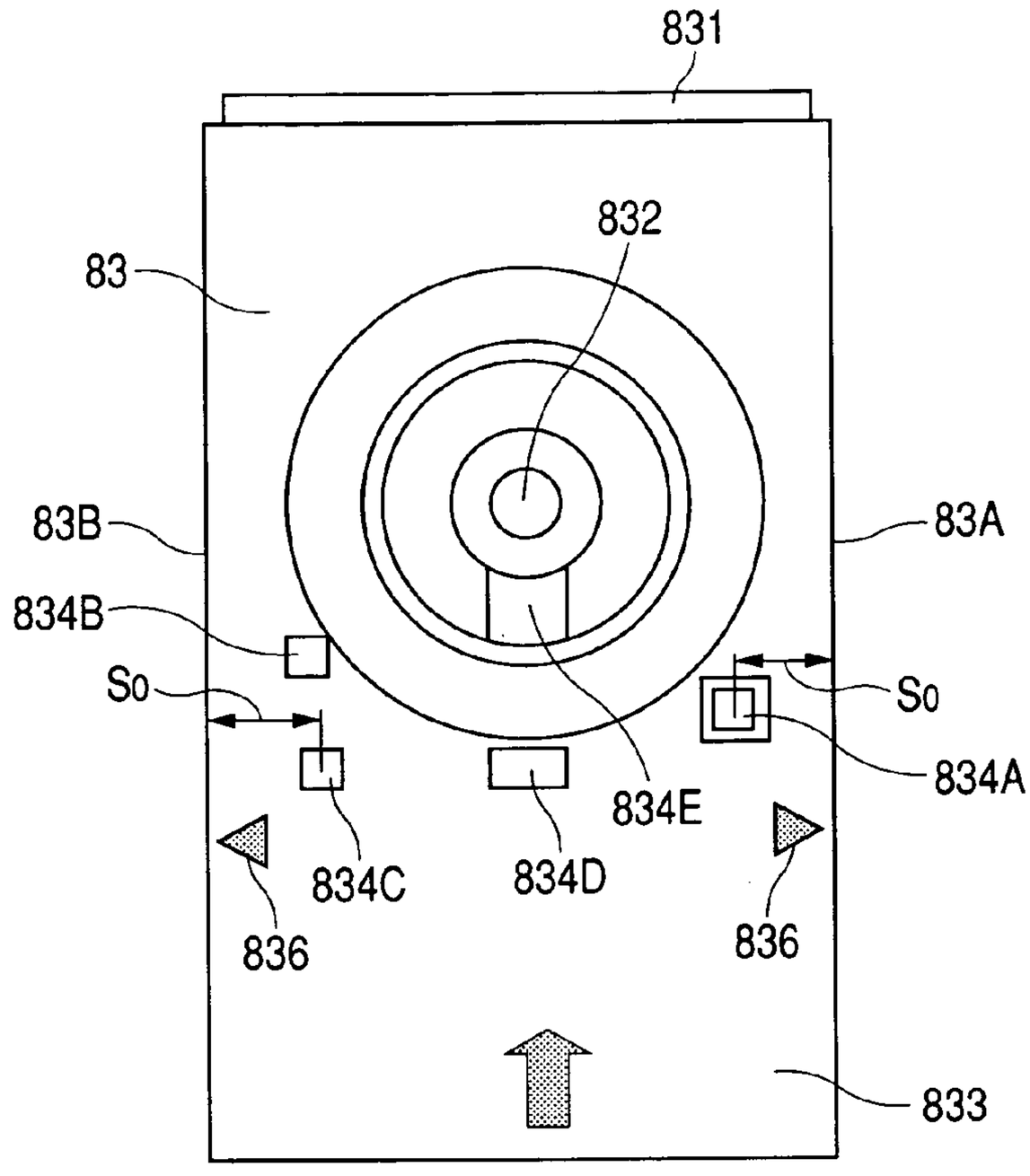


FIG. 13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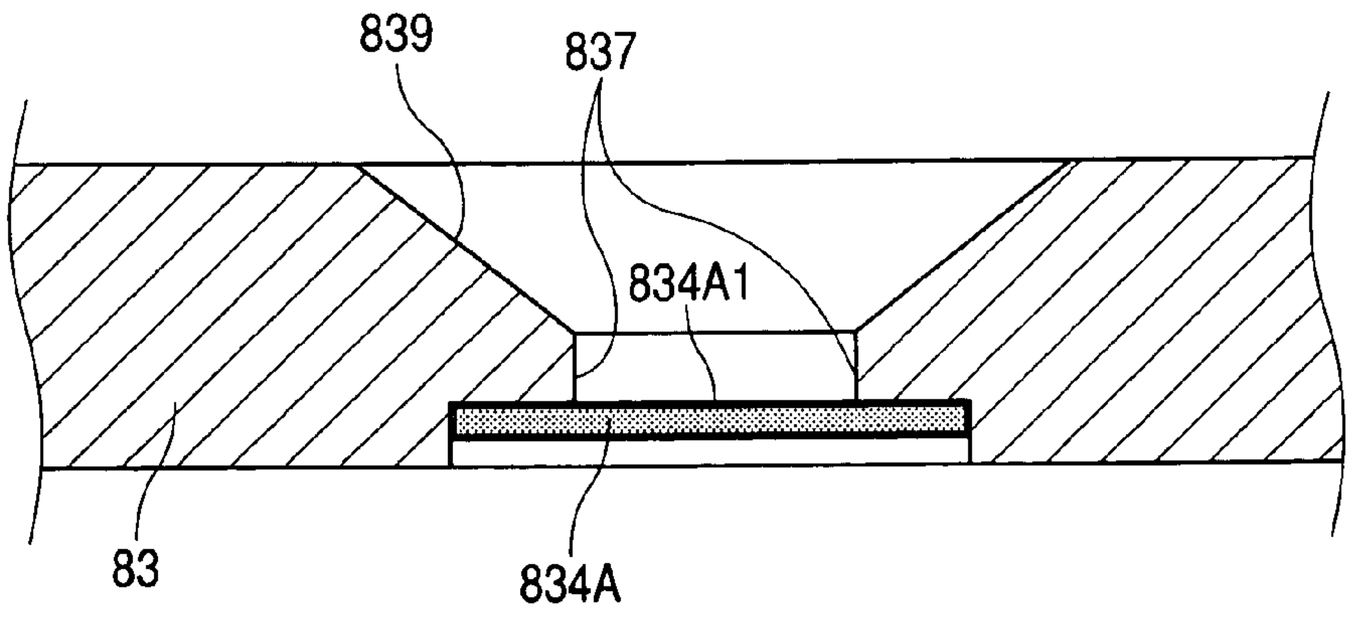
832
83
83B
83A
834B
S0
S0
834A
834E
834C
834D
836
836
833

FIG. 14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834A1
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FIG. 15

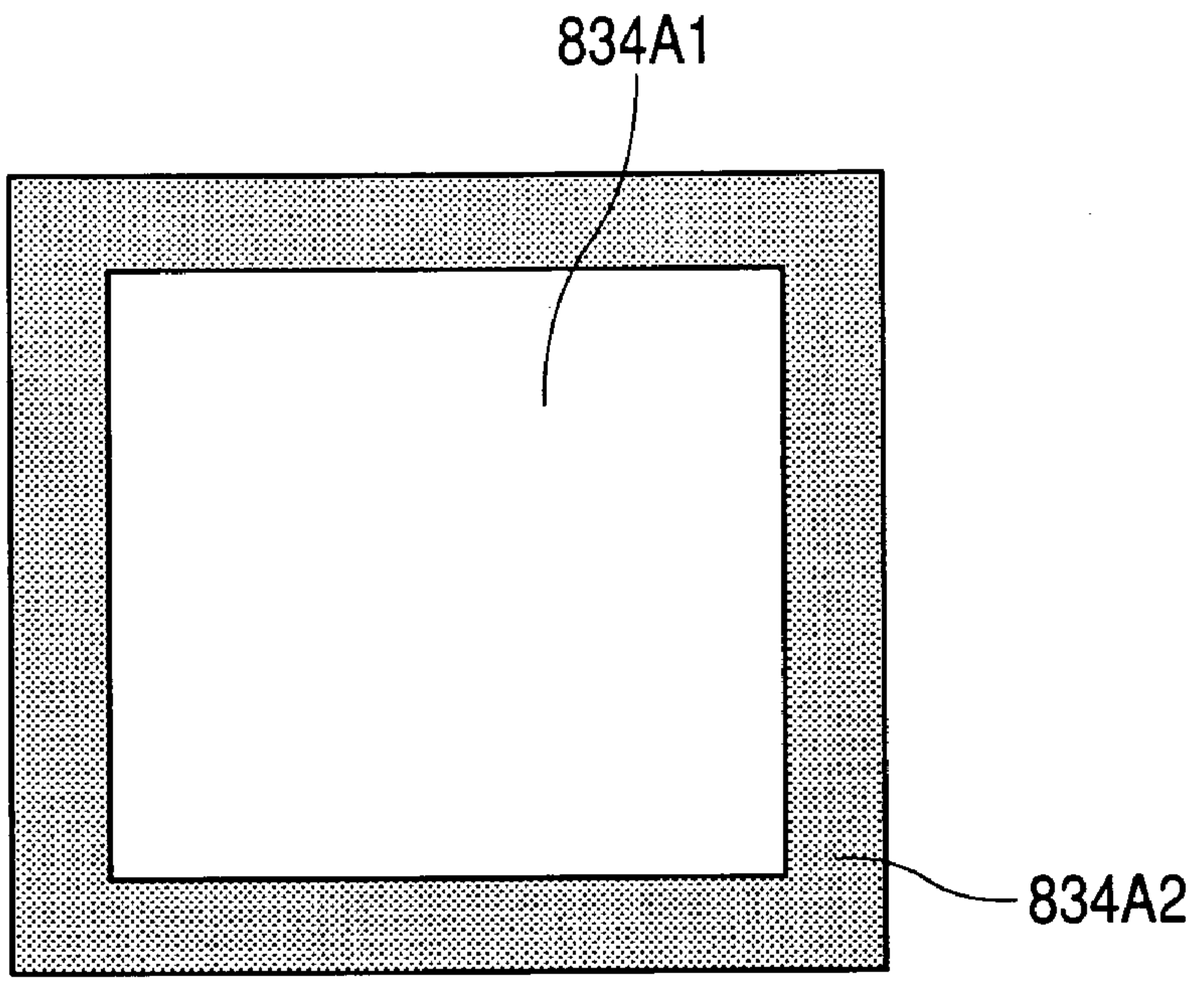


FIG. 16

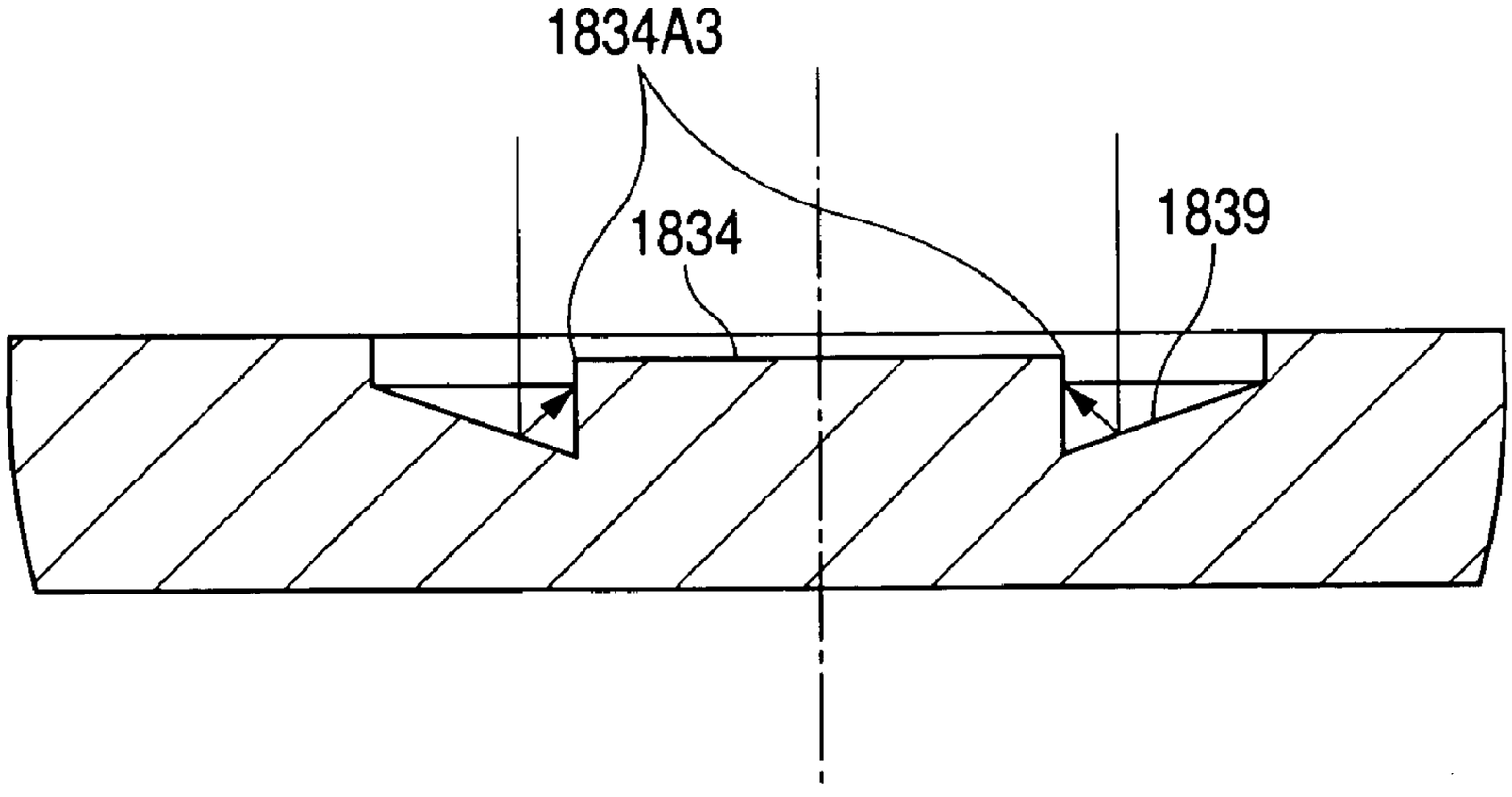


FIG. 17

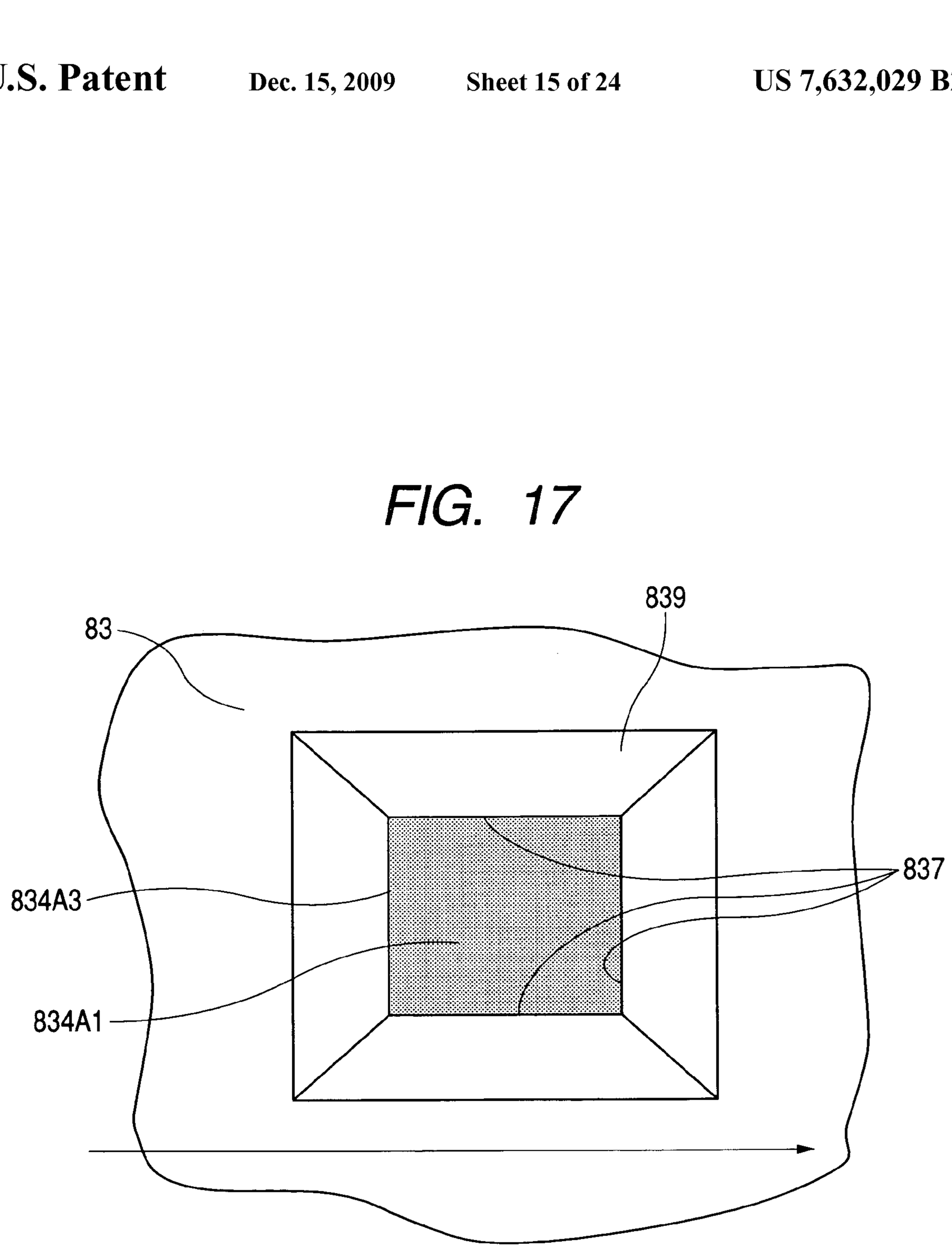


FIG. 18

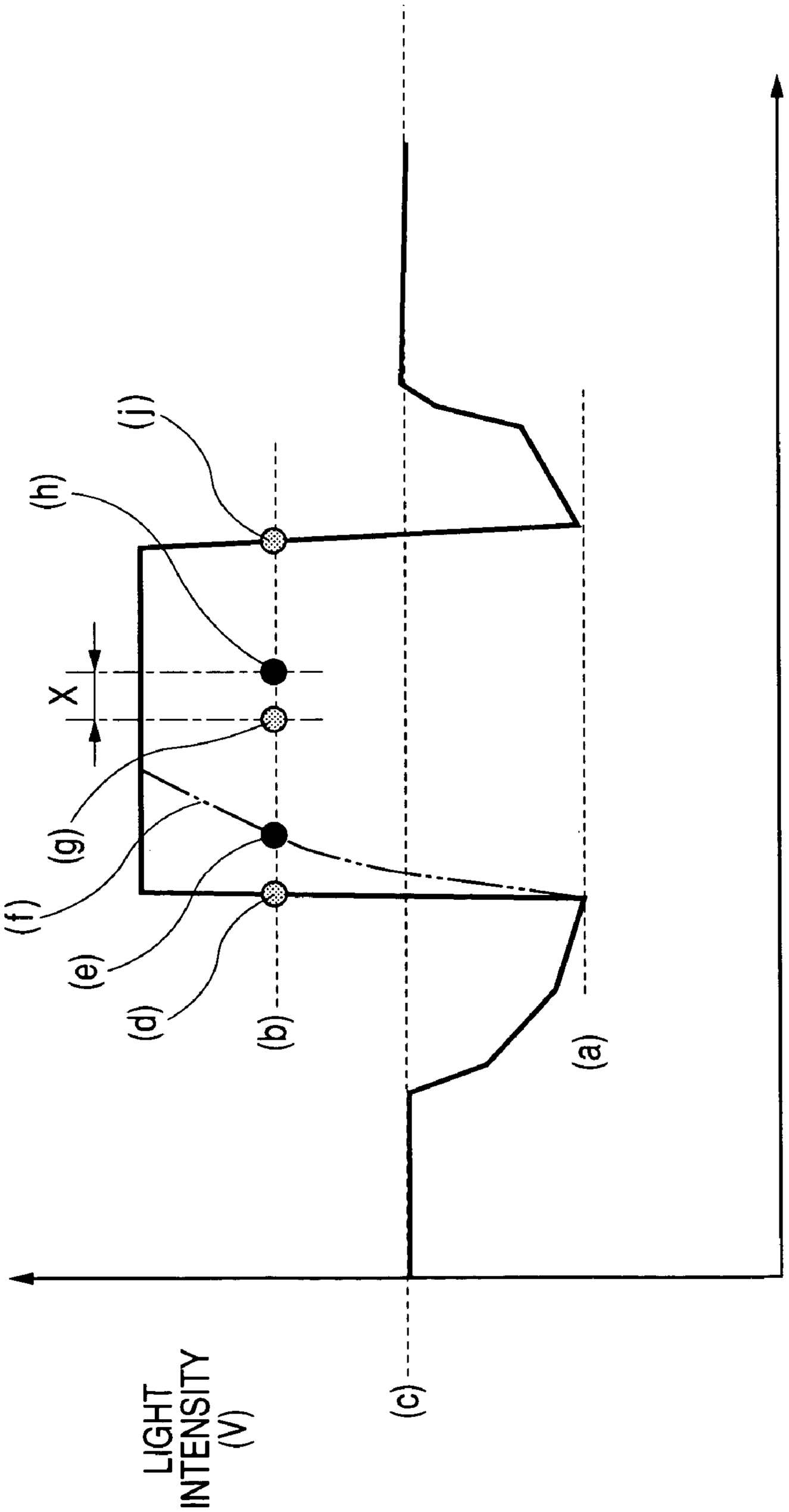


FIG. 19A

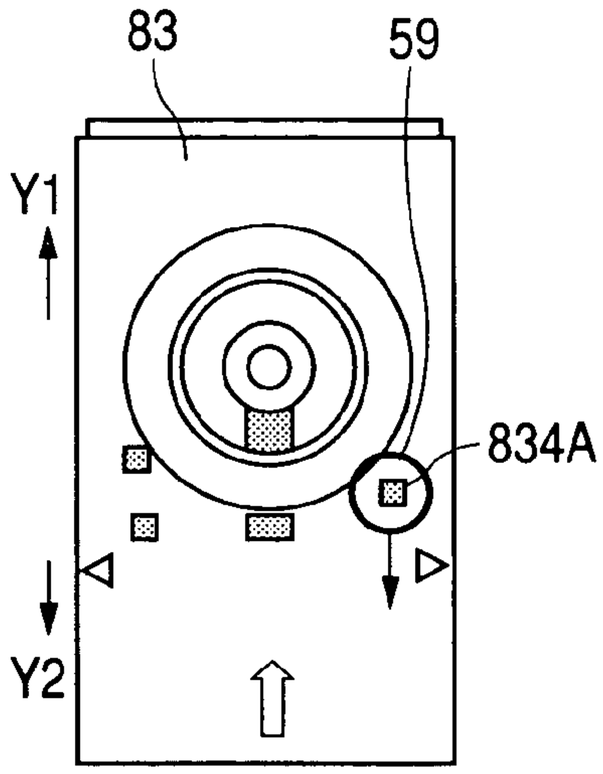


FIG. 19B

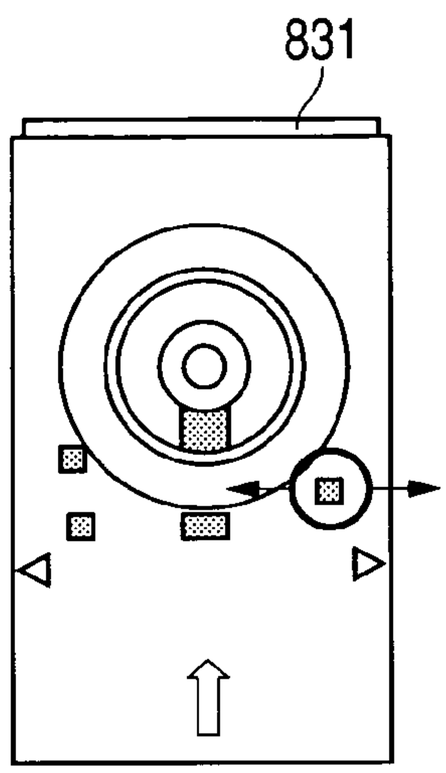


FIG. 19C

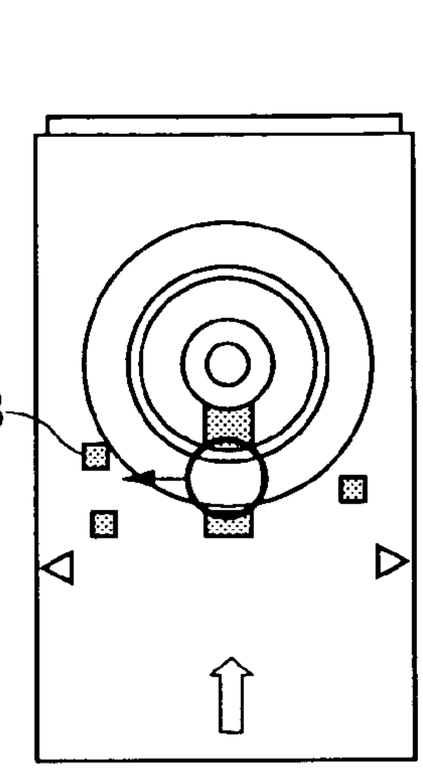


FIG. 19D

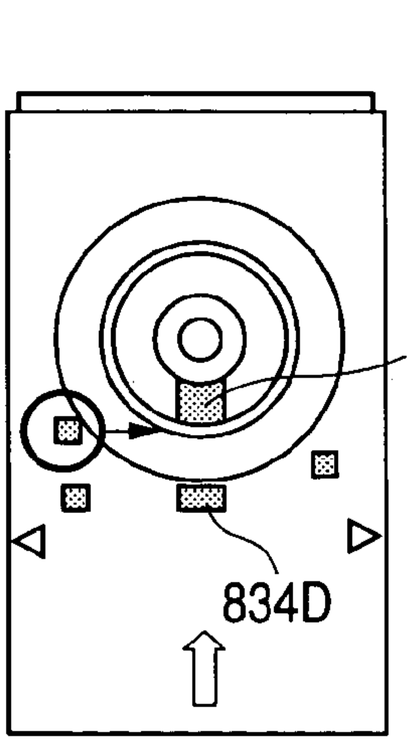


FIG. 19E

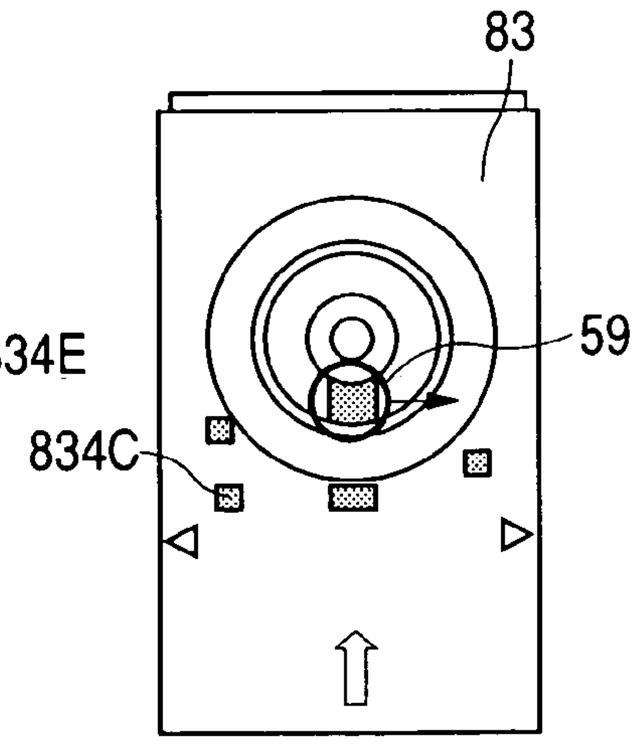


FIG. 19F

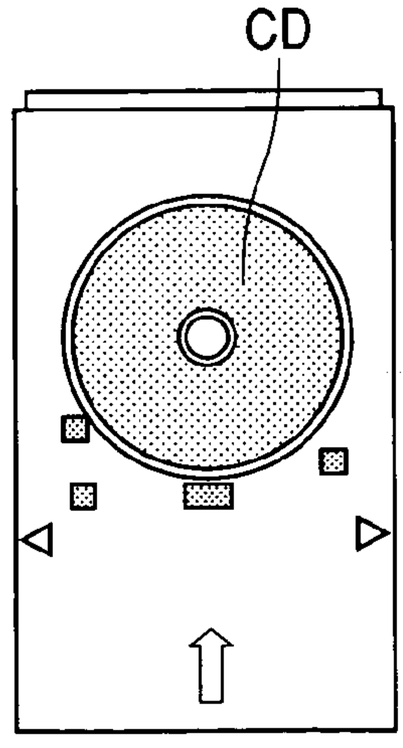


FIG. 20A

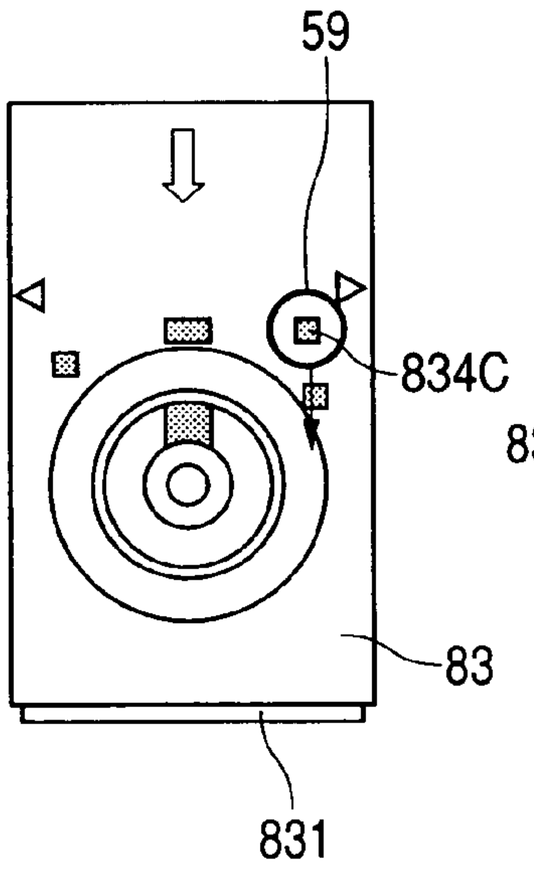


FIG. 20B

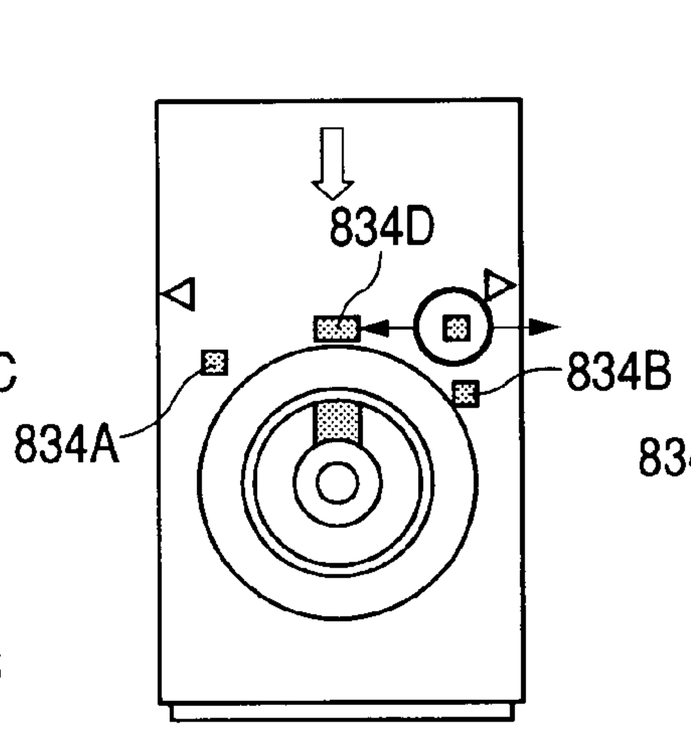
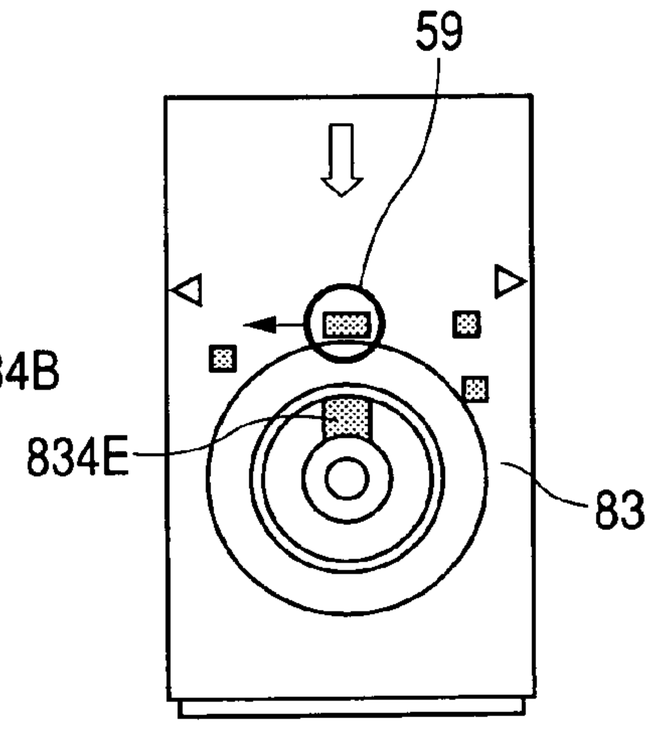


FIG. 20C



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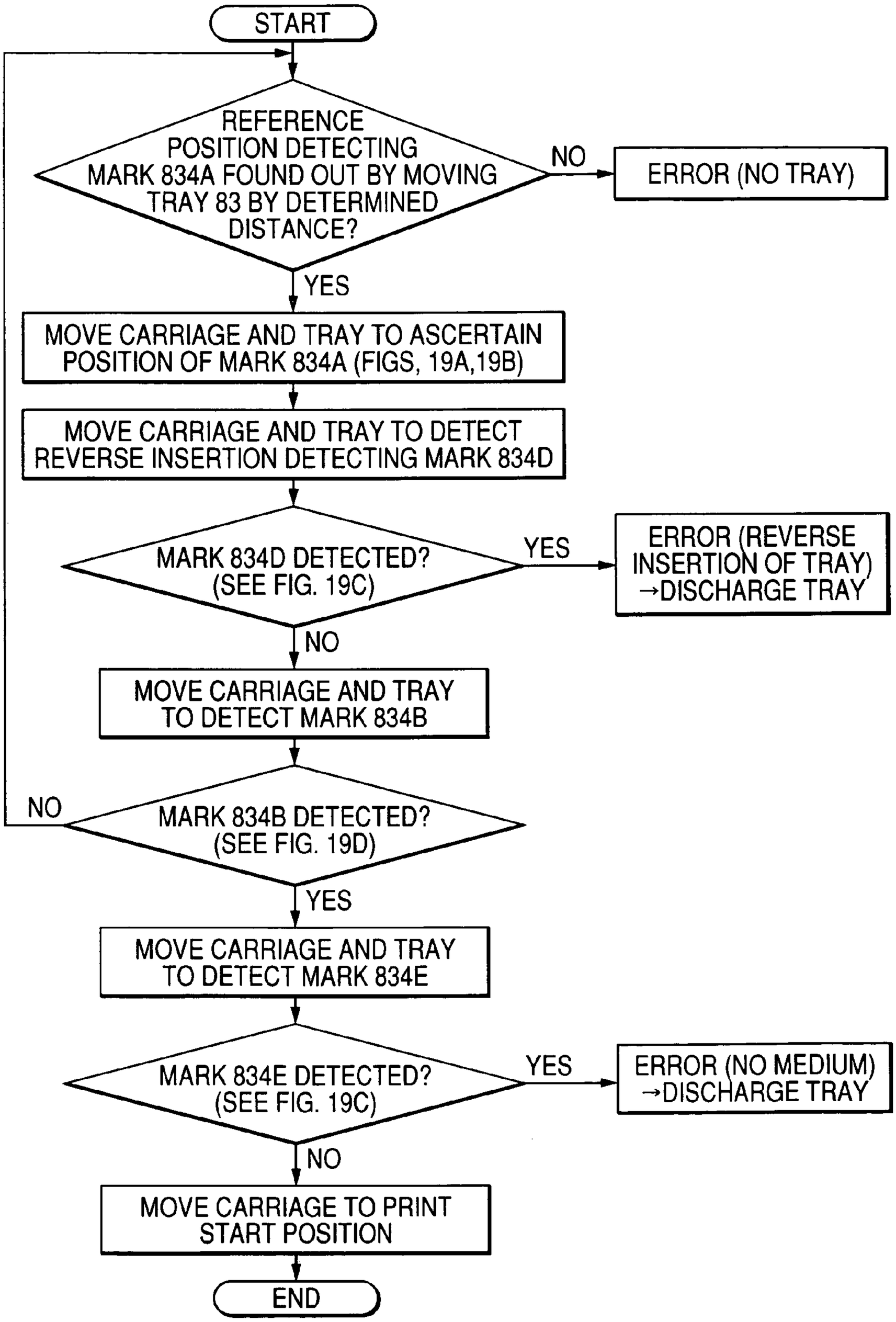

START
REFERENCE POSITION DETECTING MARK 834A FOUND OUT BY MOVING TRAY 83 BY DETERMINED DISTANCE?
NO
ERROR (NO TRAY)
YES
MOVE CARRIAGE AND TRAY TO ASCERTAIN POSITION OF MARK 834A (FIGS, 19A,19B)
MOVE CARRIAGE AND TRAY TO DETECT REVERSE INSERTION DETECTING MARK 834D
MARK 834D DETECTED? (SEE FIG. 19C)
YES
ERROR (REVERSE INSERTION OF TRAY) →DISCHARGE TRAY
NO
MOVE CARRIAGE AND TRAY TO DETECT MARK 834B
MARK 834B DETECTED? (SEE FIG. 19D)
NO
YES
MOVE CARRIAGE AND TRAY TO DETECT MARK 834E
MARK 834E DETECTED? (SEE FIG. 19C)
YES
ERROR (NO MEDIUM) →DISCHARGE TRAY
NO
MOVE CARRIAGE TO PRINT START POSITION
END

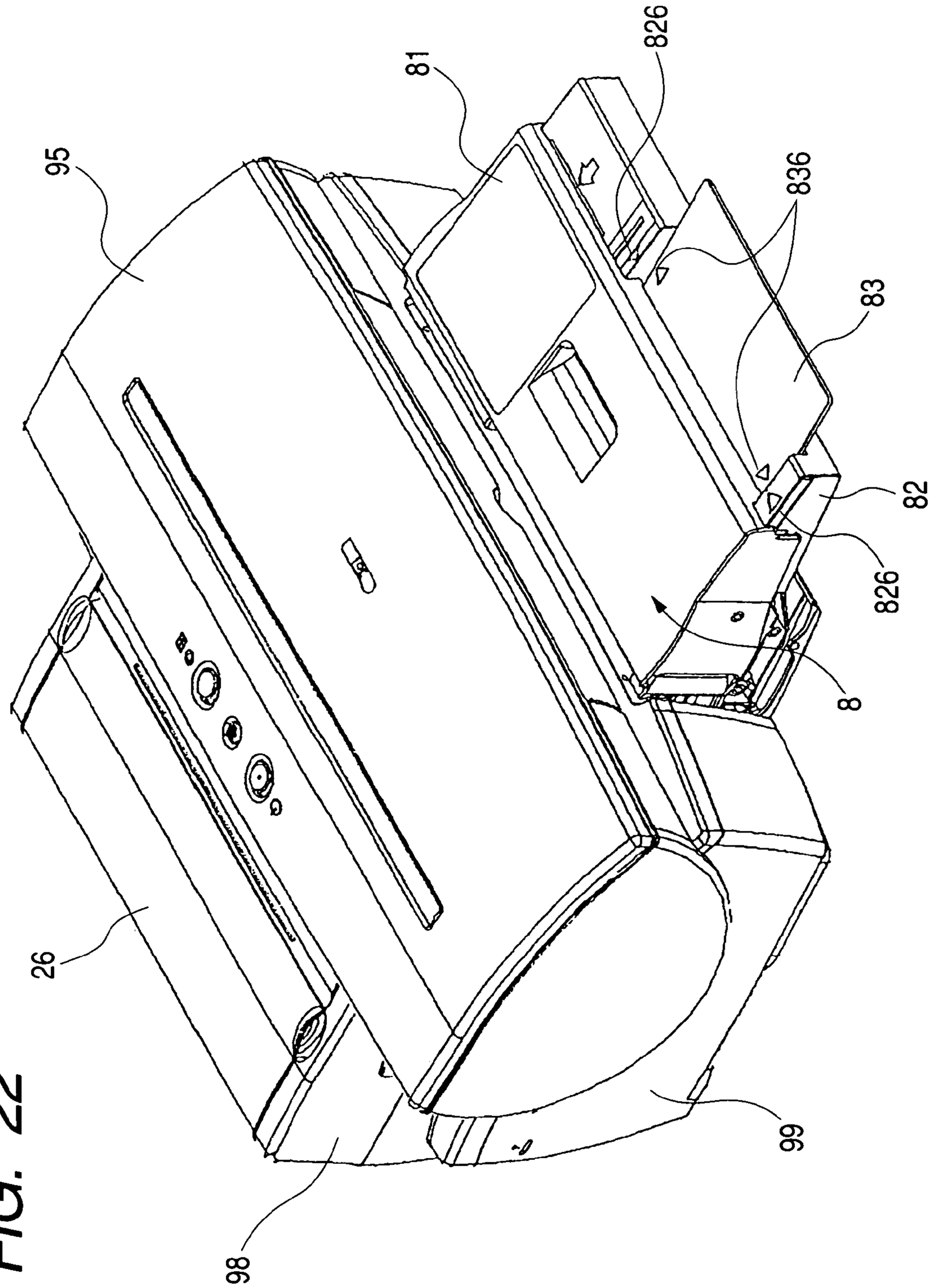


FIG. 22

FIG. 23

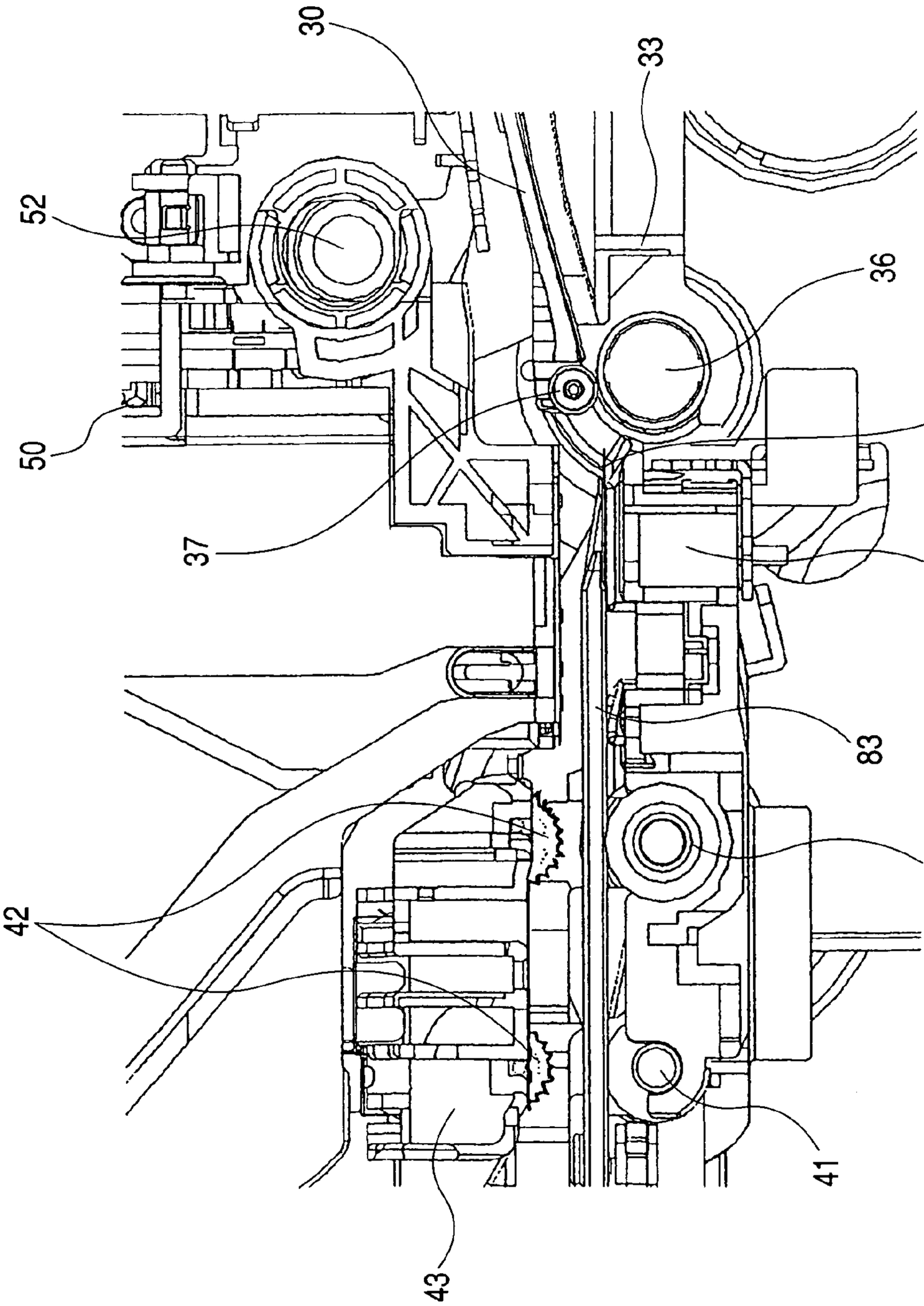


FIG. 24A

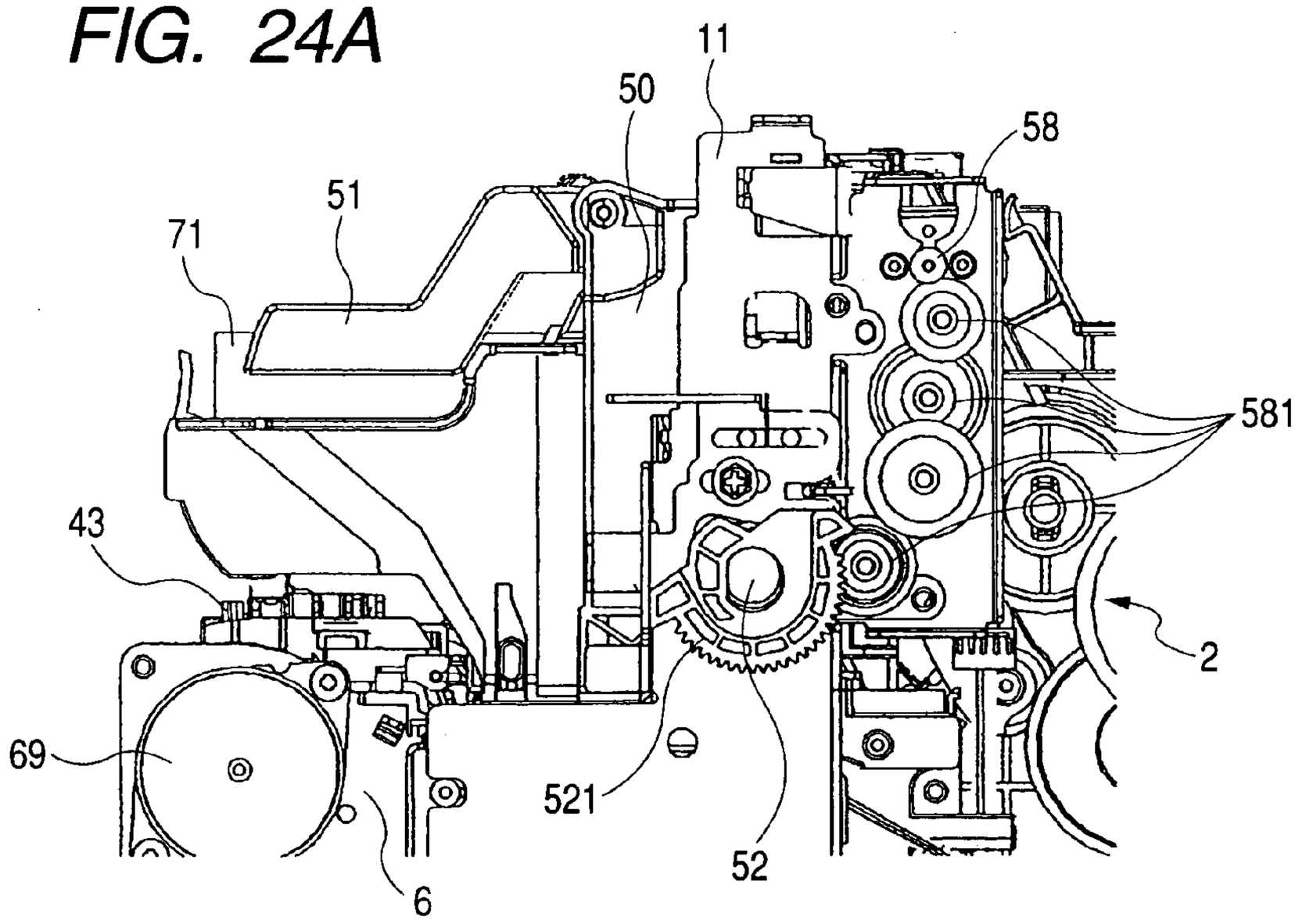


FIG. 24B

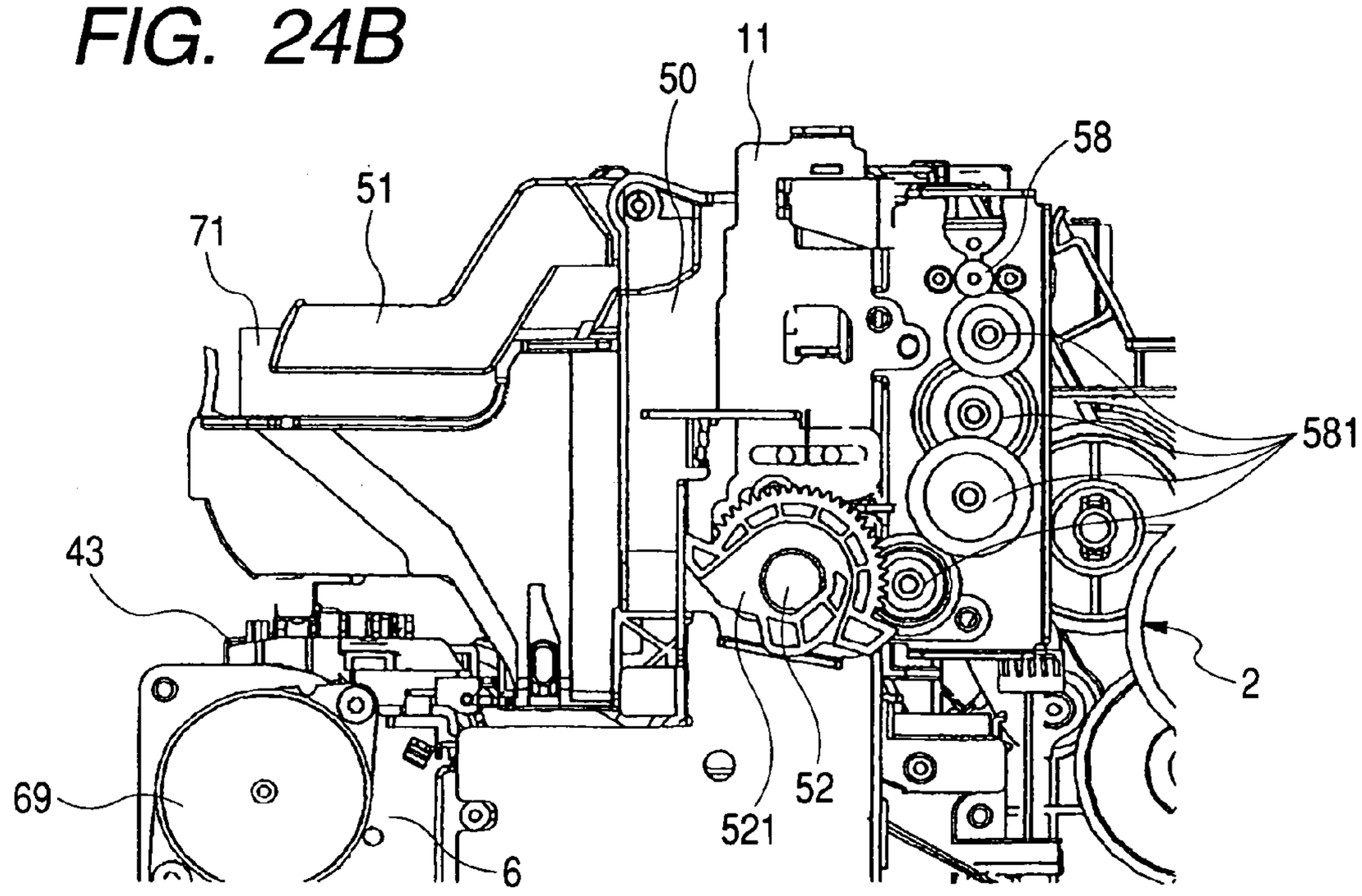


FIG. 25

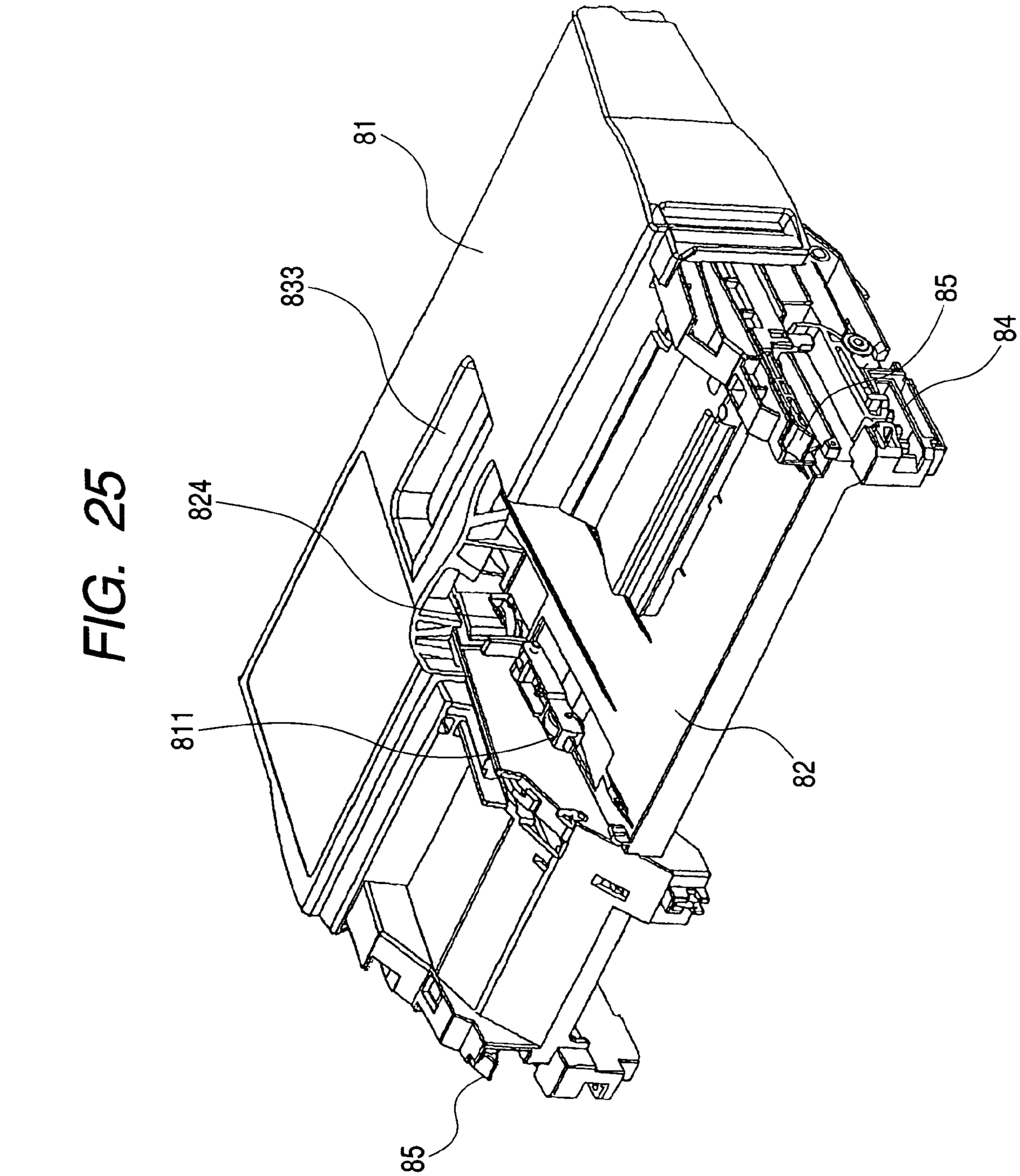


FIG. 26

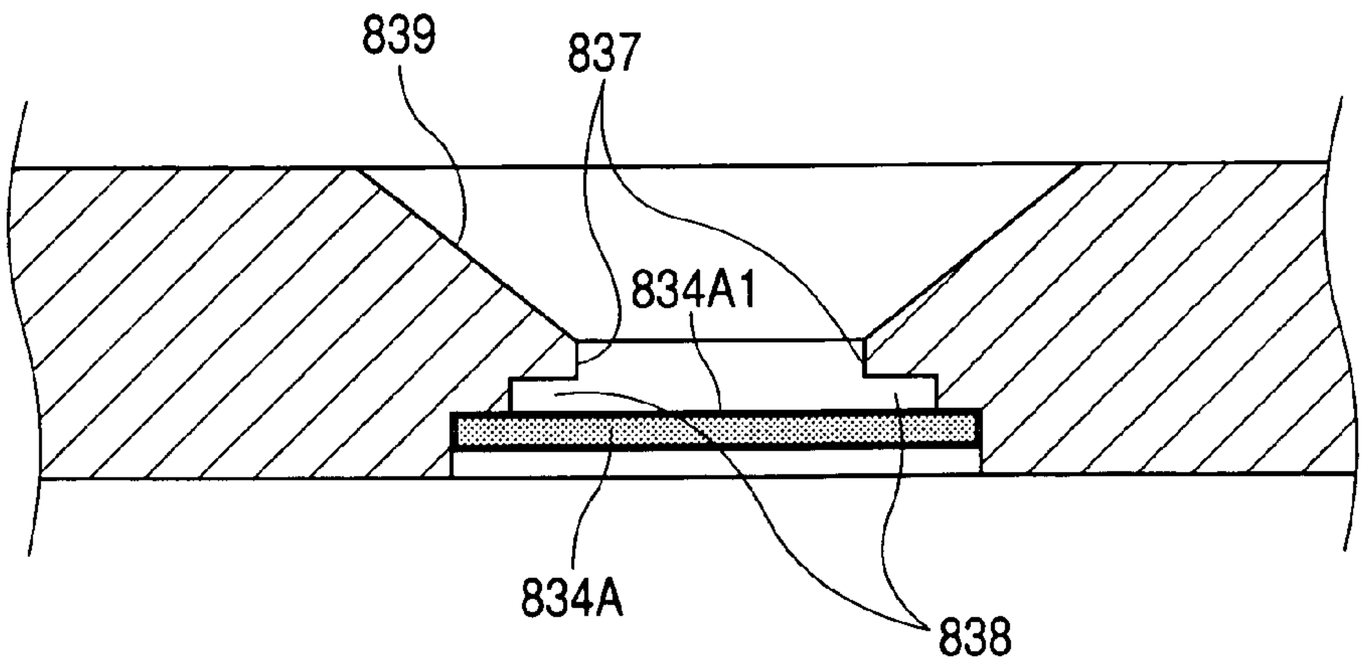
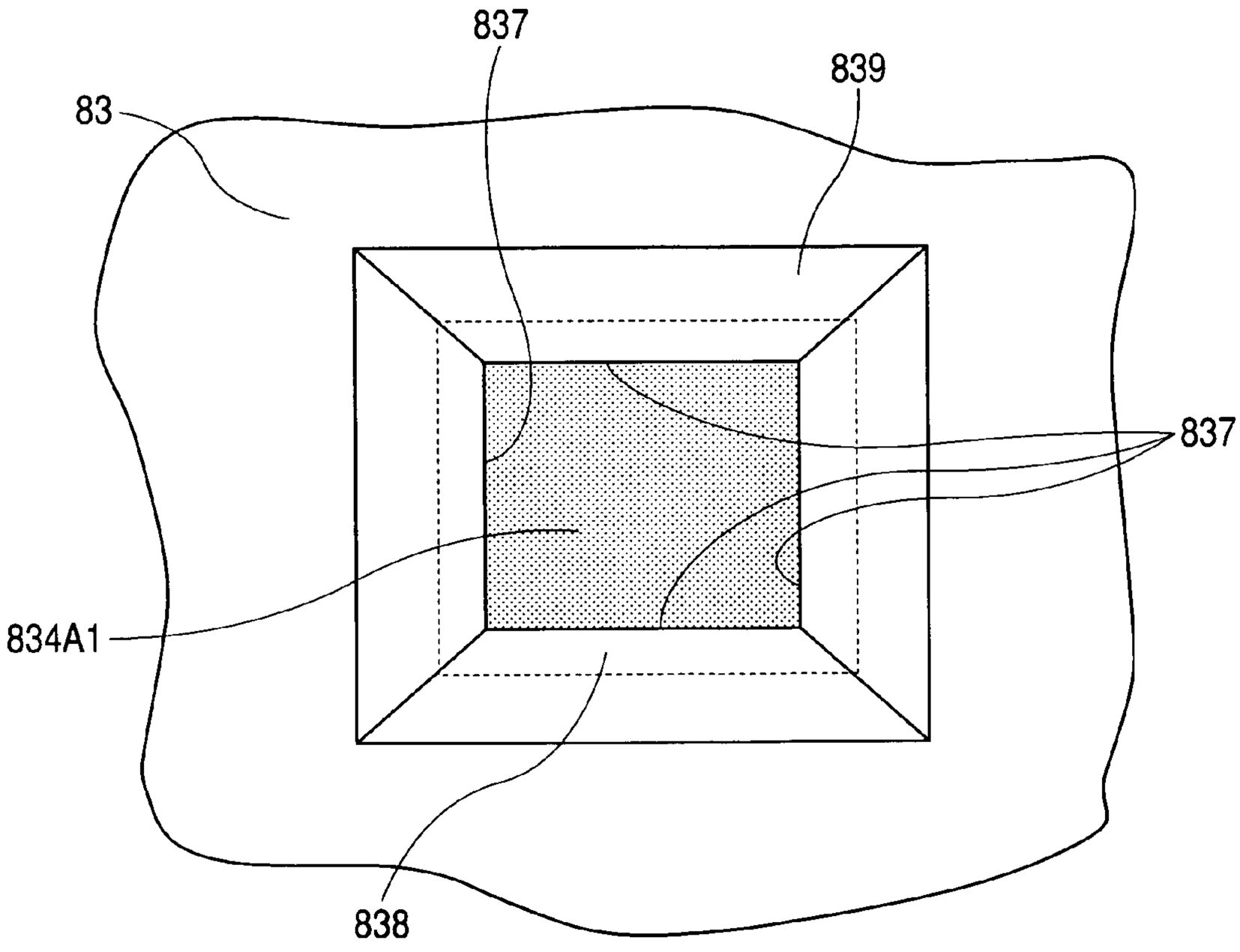


FIG. 27



RECORDING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a recording apparatus, such as a printer, and to such a recording apparatus that is capable of recording a recording member mounted on a tray with conveying the tray.

2. Related Background Art

As recording materials to be recorded by recording apparatuses, such as printers, there have been proposed a variety of media types, including small, thick recording members such as CD-Rs, DVDs and cards (hereinafter, collectively referred to as compact disks or CDs). However, when a currently available general-purpose recording apparatus, is used for the printing of a recording member such as a CD, since the recording apparatus uses the same path for conveying the recording member as it uses for a cut sheet, the high rigidity of the recording member causes the performance of the conveying process to be degraded, and either the recording member is scratched or it is not conveyed because of the distance between the feed rollers. To avoid this problem, a tray is supplied for mounting the recording member, which is thereafter conveyed along a path differing from the one used for a cut sheet.

When a recording member such as a CD is being recorded, a sensor mounted on a carriage detects a reflection plate formed on a tray to determine the recording position of the CD and performs recording. The reflection plate is formed on a raised surface on a resin tray by hot stamping. In addition, to increase the detection accuracy of reading the reflection plate, an inclined surface is formed around the reflection plate (see FIG. **16**). Further, to simplify the provision of a reflection plate, hot stamping is used to form it directly on the flat surface of the tray.

However, the following technical problems have been encountered. First, when edging at the end of the raised portion of the tray is not properly performed before the hot stamping, a reflection face edge can not be appropriately formed and detection errors may occur. Therefore, the edging of the resin must be strictly managed, which will require an inspection fee, and lessen the yield ratio, resulting in an increase in the manufacturing costs. Second, since the reflection face is formed on the raised portion of the resin, the end of the raised portion may be scratched, depending on how the tray is handled, and detection errors may occur. Third, in a case where hot stamping is used to form the reflection face directly on the surface of the tray, printing shifting caused by the hot stamping and chipping of the end portion may occur, so that there may be detection errors. Fourth, when a user erroneously sets the tray in a reverse direction to a normal one, printing may be performed on a portion other than where a CD is mounted.

SUMMARY OF THE INVENTION

It is one objective of the present invention to provide a recording apparatus that employs a tray for a thick paper, a CD-R, etc, accurately conduct recording at a low cost.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a recording apparatus according to the present invention;

FIG. **2** is a perspective view of the recording apparatus in FIG. **1** wherein a paper supply tray and a paper discharge tray are open;

FIG. **3** is a perspective view, taken from the right front, of the internal arrangement of the recording apparatus in FIG. **1**;

FIG. **4** is a perspective view, taken from the left front, of the internal arrangement of the recording apparatus in FIG. **1**;

FIG. **5** is a vertical cross-sectional view of the recording apparatus in FIG. **3**;

FIGS. **6**A and **6**B are, respectively, perspective views of the recording apparatus in FIG. **1** before and after a CD conveying unit is mounted;

FIG. **7** is a perspective view of the CD conveying unit that can be mounted in the recording apparatus in FIG. **1**;

FIG. **8** is a fragmentary perspective view of a CD conveying unit attachment portion and an attachment detector in the lower case of the recording apparatus in FIG. **1**;

FIG. **9** is a fragmentary vertical cross-sectional view of the state wherein a hook of the CD conveying unit engages the lower case of the recording apparatus in FIG. **1**;

FIGS. **10**A and **10**B are, respectively, perspective views of the states wherein a slide cover is moved before and after the CD conveying unit is mounted;

FIG. **11** is a fragmentary vertical cross-sectional view of the state wherein the hook of the conveying unit is disengaged from the lower case of the recording apparatus;

FIGS. **12**A and **12**B are, respectively, fragmentary vertical cross-sectional views of the states of an arm before and after the slide cover of the CD conveying unit is moved;

FIG. **13** is a schematic plan view showing on a tray a means for calculating a recording position of a CD in the recording apparatus according to the present invention;

FIG. **14** is a vertical cross-sectional view of the structure of a tray position detector according to a first embodiment of the present invention;

FIG. **15** is a plan view of a reflection plate of the tray position detector in FIG. **14**;

FIG. **16** is a schematic vertical cross-sectional view of an example reference structure for the tray position detector;

FIG. **17** is a fragmentary plan view for explaining the positional relationship between a tray and a position sensor according to the first embodiment of the invention;

FIG. **18** is a graph showing as an example a change in light intensity during a reflection plate detection sequence for detecting the location of the tray according to the first embodiment of the invention;

FIGS. **19**A, **19**B, **19**C, **19**D, **19**E and **19**F are diagrams for explaining the processing for detecting a detection mark when the tray is inserted in the normal direction;

FIGS. **20**A, **20**B and **20**C are diagrams for explaining the processing for detecting the detection mark when the tray is inserted in the opposite direction;

FIG. **21** is a flowchart showing a detection sequence performed by the recording apparatus of the invention using the detection mark on the tray;

FIG. **22** is a schematic perspective view of the recording apparatus of the invention wherein the tray is set;

FIG. **23** is a vertical cross-sectional view of the recording apparatus of the invention wherein the tray is conveyed;

FIGS. **24**A and **24**B are fragmentary cross-sectional views for explaining the arrangement and the operation of a carriage guide shaft elevating mechanism provided for the recording apparatus of the present invention, with FIG. **24**A showing the operation for lowering a carriage and FIG. **24**B showing the operation for raising the carriage;

FIG. **25** is a schematic perspective view for explaining the actions, relative to the tray, of a side pressure roller and a pressing roller of the CD conveying unit of the recording apparatus according to the invention;

FIG. **26** is a vertical cross-sectional view of the structure of a tray position detector according to a second embodiment of the invention; and

FIG. **27** is a plan view, taken from the surface of a tray, of the tray position detector in FIG. **26**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The preferred embodiments of the present invention will now be specifically explained while referring to the accompanying drawings. Throughout the drawings, the same reference numerals are employed to denote identical or corresponding components. FIG. **1** is a perspective view of a recording apparatus according to the present invention, and FIG. **2** is a perspective view of the recording apparatus in FIG. **1**, wherein a paper supply tray and a paper discharge tray are open. FIG. **3** is a perspective view, taken from the right front, of the internal arrangement of the recording apparatus in FIG. **1**, and FIG. **4** is a perspective view, taken from the left front, of the internal arrangement of the recording apparatus in FIG. **1**. FIG. **5** is a vertical cross-sectional view of the recording apparatus in FIG. **3**. In FIGS. **1** to **5**, a recording apparatus **1** comprises a paper supply unit **2**, a sheet conveying unit **3**, a paper discharge unit **4**, a carriage **5**, a cleaning unit (recovery mechanism) **6**, a recording head (recording means) **7**, a CD conveying unit **8** and an electric unit **9**.

For the paper supply unit **2**, a pressure plate **21**, on which sheets P, such as recording sheets, are mounted, a feed roller **28**, for feeding a sheet P, a separation roller **241**, for separating sheets P, and a return lever **22**, for returning sheets P to a stacked position, are attached to a base **20**. A paper supply tray **26**, used for holding the sheets P in the stacked position, is attached to the base **20** or the outer case of the recording apparatus **1**. As is shown in FIG. **2**, the paper supply tray **26** is a multistage type, and is pulled out for use. The feed roller **28** is rod-like and of circular arc in cross section, on which rubber material is provided, at a position loses to a sheet reference, and is used to feed a sheet P. The feed roller **28** is driven by a driving force transmitted by a feed motor **273**, which is provided in the paper supply unit **2**, through a drive transmission gear **271** and a planetary gear **272**.

In the normal standby state, the pressure plate **21** is released by a pressure plate cam **214**, the separation roller **241** is released by a control cam **25**, and the return lever **22** is located at a stacking position whereat the sheets P are returned to the stacking position and a stacking port is blocked to prevent the stacked sheets P from entering farther. When the supply of paper is started, first, the motor drives the separation roller **241** to contact the feed roller **28**. Then, the return lever **22** is released, and the pressure plate **21** is brought into contact with the feed roller **28**. In this state, the supply of the sheet P is begun. The sheets P are controlled by a front stage separation unit **201**, which is provided on the base **20**, and only a predetermined number of sheets P are transmitted to a nip portion that is formed by the feed roller **28** and the separation roller **241**. The sheets P are separated at the nip portion, and only the topmost sheet P is fed.

The sheet conveying unit **3** is attached to a chassis **11** made of bent sheet metal, and includes a conveying roller **36**, for conveying the sheet P, and a PE sensor **32**. The conveying roller **36** is formed by coating the surface of a metal shaft with ceramic particles, and is attached to the chassis **11** by holding the metal portions of the shaft at a bearing **38**. In order to stably convey a sheet P by using the conveying roller **36**, a conveying roller tension spring **381** is located between the bearing **38** and the conveying roller **36**. When the conveying roller tension spring **381** urges the conveying roller **36** forward, a predetermined load is imposed on the conveying roller **36**.

A plurality of coupled, driving pinch rollers **37** are so provided that they contact the conveying roller **36**. The pinch rollers **37** are held by a pinch roller holder **30**, and are pressed against the conveying roller **36** by a pinch roller spring **31** to generate a conveying force for the sheet P. The rotary shaft of the pinch roller holder **30** is fitted on a fearing and the pinch roller holder **30** rotates around the rotary shaft. A paper guide flapper **33** and a platen **34**, for guiding the sheet P, are arranged at the entrance of the paper conveying unit **3** to which the sheet P is to be conveyed. And the pinch roller holder **30** includes a PE sensor lever **32** for notifying the PE sensor **32** when the leading edge or the trailing edge of the sheet P has been detected.

The platen **34** is attached to and positioned on the chassis **11**. The paper guide flapper **33** is rotatable at a bearing **331** that engages the conveying roller **36** and slides backward and forward, and it is positioned by contacting with the chassis **11**. A paper release lever **341**, for covering the end of the sheet P, is located on the paper reference side of the platen **34**, and for a sheet P having a deformed or curled end, the paper release lever **341** prevents the end of the sheet P from being raised and interfering with the carriage **50** or the recording head **7**. The recording head **7**, for recording images based on image data, is located downstream, in a sheet conveying direction the conveying roller **36**.

With this arrangement, the sheet P conveyed to the paper conveying unit **3** is guided by the pinch roller holder **30** and the paper guide flapper **33**, and is fed to the conveying roller pair consisting of the conveying roller **36** and the pinch roller **37**. At this time, the leading edge of the sheet P conveyed by the pinch sensor lever **321** is detected to obtain the recording position of the sheet P, while, as the paired conveying rollers **36** and **37** are rotated by a conveying motor **35**, the sheet P is transmitted along the platen **34**. On the platen **34**, a rib is formed that acts as a conveying reference face and that manages a gap between it and the recording head **7** and that, together with the paper discharge unit, which will be described later, reduces undulation of the sheet P.

The conveying roller **36** is driven by the transmission of the rotational force of the conveying motor **35** being a DC motor, to a pulley **361** that is fitted around the shaft of the convey roller **36**, by a timing belt **351**. A cord wheel **362**, on which marks are formed, at pitches of 150 to 300 lpi, to detect an amount of the sheet conveyance by the convey roller **36**, is provided on the shaft of the conveying roller **36**, and an encoder sensor **36**, for reading the marks, is attached to the chassis **11** at a position adjacent to the cord wheel **362**. As for the recording head **7**, an ink jet recording head, is used which has exchangeable ink tanks for individual colors mounted therein. This recording head F is arranged to heat inks by using a heater (a heat-generating device) or the like. When the ink is heated, film boiling occurs, whereby bubbles are expanded or shrunk to cause change in the pressure and thus eject ink, through orifices in the recording head **7**. By the ejected ink droplets, an image is formed on a recording material, such as the sheet P.

The carriage unit **5** includes the carriage **50**, on which the recording head **7** is mounted. The carriage **50**, supported by a guide shaft **52** and a guide rail **111** positioned perpendicular to the direction in which the sheet P is conveyed, reciprocates in the main scanning direction, and is driven, via a timing belt **541** extended by an idle pulley **542**, by a carriage motor **54** that is attached to the chassis **11**. Further, in order to detect the location of the carriage **50**, a cord strip **561**, whereon marks

are formed at pitches of 150 to 300 lpi, is positioned parallel to the timing belt **541**, and an encoder sensor **56**, for reading the cord strip **561**, is provided on a carriage board **92** mounted on the carriage **50**. Also provided on the carriage board **92** is a contact **921** used for an electric connection to the recording head **7**. Furthermore, a flexible board **57** for transmitting a head signal from an electric unit (electric board) **9** to the recording head **7**, is also provided in the carriage **50**.

In order to secure the recording head **7** to the carriage **50**, pressing means **511** is provided in the carriage **50** to push and securely fix the recording head **7** against a positioning stopper **501**. Eccentric cams **521** are provided on both ends of the guide shaft **52**, and when the driving force produced by a carriage elevating motor **58** is transmitted to the eccentric cams **521**, through a gear string **581**, the guide shaft **52** is either elevated or lowered. As the guide shaft **52** is elevated or lowered, the carriage **50** is also elevated or lowered, and an optimum gap can be formed for sheets P of different thicknesses.

A sensor **59**, which is a reflector type optical sensor, is attached to the carriage **50** to detect a to-be-detected portion (to-be-detected portion or detection mark) **834** on a CD printing tray **83**, which will be described later. For recording performed on the display portion of a small, thick recording material, such as a CD-R, the tray **83** is conveyed with the small, thick recording material mounted thereon. The sensor **59** emits light by using a light emitting device and receives reflected light to thereby detect the location of the tray **83**. With this arrangement, to record the sheet P, the paired convey rollers **36** and **37** convey the sheet P to the position for a row to be recorded, and the carriage motor **54** moves the carriage **50** to a recording position to cause the recording head **7** to face the recording location. Thereafter, upon receiving a signal from the electric unit **9**, the recording head **7** ejects ink onto the sheet P, and as a result, forms an image thereon.

The paper discharge unit **4** includes: two discharge rollers **40** and **41**, which are attached to the platen **34**; spurs **42**, which can perform coupled driving, under a predetermined pressure, while in contact with the discharge rollers **40** and **41**; and a gear string for transmitting the driving force from the conveying roller **36** to the discharge rollers **40** and **41**. A plurality of rubber portions (discharge roller rubber) **401** are provided around the metal shaft of the discharge roller **40**, which is located upstream in the sheet conveying direction, and the discharge roller **40** is driven by a driving force from the conveying roller **36** transmitted by an idler gear. The discharge roller **41** that is located downstream, is so structured that a plurality of flexible members **411**, composed of elastomer, are provided around the resin shaft. The discharge roller **41** is driven by a driving force from the discharge roller **40** transmitted via the idler gear.

The spurs **42** are attached to a spur holder **43**, and in the present invention, a spur spring **44**, which is a coil spring having a rod-like shape, is employed to attach the spurs **42** to the spur holder **43** and to apply pressure, through the spurs **42**, to the discharge rollers **40** and **41**. As for the spurs **42**, there are two types: a type that mainly generates a force for conveying a sheet P, and a type that mainly prevents a sheet P from being raised during a recording operation. The spur that generates the conveying force is located at a position corresponding to the rubber portion (a discharge roller rubber portion or a flexible member portion) of the discharge roller **40** or **41**, and the spur that prevents the sheet P from being raised is located at a position (between the rubber portions **401**) whereat the rubber portions **401** of the discharge rollers **40** and **41** are not present.

A paper end support **45**, arranged between the discharge rollers **40** and **41**, raises both ends of a sheet P **40** and **41**, to hold the sheet P ahead thereof so that an image recorded on the sheet P discharged previously is protected from damage or quality deterioration due to rubbing. For the paper end support **45**, a resin member, whereon a roller **451** is located at the distal end, is urged by a paper end support spring **452**. In this manner, both ends of the sheet P are raised and held to provide a tear-resistant body.

With the above described arrangement, the sheet P on which an image is formed by the carriage unit **5** is conveyed while sandwiched by the nip portion between the discharge roller **41** and the spur **42**, and is discharged to a paper discharge tray **46**. The paper discharge tray **46** has a segmented structure and is composed of a plurality of members, and can be stored in the lower portion of a lower case **99** of the recording apparatus **1**. The paper discharge tray **46** is pulled out for use. In the drawings, the height of the paper discharge tray **46** increases toward the tip, and the side edges of the tray are also high. With this structure, discharged sheets P can be stacked more appropriately, and the recording faces of the sheets P can be protected from rubbing.

The cleaning unit (recovery mechanism) **6** includes: a suction pump **60**, for performing a suction recovery process to maintain or recover the ejection performance of the recording head **7**; a cap **61**, for protecting the orifice faces of the recording head **7** and preventing the drying of the orifices; a wiper blade **62**, for removing an extraneous substance, such as ink or dust, from the area around the orifices of the recording head **7**; and a special recovery motor **69**. The cleaning unit **6** also includes a one-way clutch **691**, for driving the suction pump **60** by employing the uni-directional rotation of the recovery motor **69** to operate the wiper blade **62** and elevate the cap **61**.

The suction pump **60** generates a negative pressure by using a pump roller **68** to rub or stroke two tubes **67**, and the suction pump **60** and the cap **61** are connected via a valve **65** or the like. The suction recovery means, which includes the suction pump **60**, drives the suction pump **60** and generates a negative pressure in the cap **61** that closely seals the orifice face of the recording head **7**, and under this negative pressure, a foreign substance, such as viscous ink, bubbles or dust, so well as ink is attracted to and discharged from the orifices of the recording head **7**. A cap absorption member **611** is provided on the cap **61** to reduce the quantity of ink remaining in the orifices after the suction process has been performed. To prevent the residual and fixation of ink and the occurrence of damage owing to the fixation ink remaining in the cap **61** is attracted while the cap **61** is open. The waste ink sucked by the pump **60** is collected and held by a waste ink absorption member **991** (FIG. **9**) provided in the lower case **99**, which will be described later.

The individual functional units described above, which are assembled within the chassis **11** of the recording apparatus **1**, provide the mechanisms for the recording apparatus **1**, and to enclose these mechanisms, an outer case is attached. The outer case is constituted mainly by a lower case **99**, an upper case **98**, an access cover **97**, a connector cover **96** and a front cover **95**. A paper discharge tray rail **992** is provided in the lower portion of the lower case **99** to store the segmented (extendable) paper discharge tray **46**. And the front cover **95** closes the paper discharge port when the paper discharge tray **46** is not in use.

A detailed explanation will now be given for the configuration of and the printing processing performed by the recording apparatus when an image is printed on the surface of a compact disc (CD). This CD printing processing is performed by using the CD conveying unit **8** provided in the recording

apparatus. FIGS. **6**A and **6**B are respective views of the recording apparatus before and after the CD conveying unit **8** is mounted. FIG. **7** is a perspective view of the CD conveying unit **8** that can be mounted in the recording apparatus in FIG. **1**. FIG. **8** is a fragmentary perspective view of the CD conveying unit attachment portion and the attachment detector of the lower case **99** for the recording apparatus in FIG. **1**. FIG. **9** is a fragmentary vertical cross-sectional view of the state wherein hooks **84**, provided in the CD conveying unit **8**, engage the lower case **99** of the recording apparatus in FIG. **1**. FIGS. **10**A and **10**B are respective perspective views of the states wherein a slide cover **81** is moved before and after the CD conveying unit **8** is mounted. FIG. **11** is a fragmentary vertical cross-sectional view of the state wherein the hooks **84** on the CD conveying unit **8** are disengaged from the lower case. FIGS. **12**A and **12**B are respective fragmentary vertical cross-sectional views of the states of arms **85** before and after a slide cover **81** of the CD conveying unit **8** is moved. And FIG. **13** is a schematic plan view showing on a tray a means for calculating a recording position of a CD in the recording apparatus of the present invention.

As is shown in FIGS. **6**A and **6**B, when the CD conveying unit **8** is slid linearly in the direction Y, the CD conveying unit **8** is attached to the lower case **99** of the recording apparatus **1**. At this time, engagement portions **822**, at both side ends of a tray guide **82**, are inserted along guide rails **993**, provided on both sides of the lower case **99** shown in FIGS. **8** and **9**, to position the CD conveying unit **8**. The pivotable hooks **84** are provided at both ends of the tray guide **82** and are urged in one direction. When the CD conveying unit **8** is inserted and moved to a predetermined position, it abuts upon a predetermined portion that prevents its further insertion. Then, the hooks **84**, by engaging the stopper of the guide rails **993**, lock the CD conveying unit **8** in place and prevent it from returning in the direction in which it was slid.

A sensor **344** is provided for the platen **34** to mechanically detect the state wherein the tray guide **82** (tray conveying unit **8**) has been mounted at a predetermined position in the recording apparatus **1**. When the tray guide **82** is attached to the main body of the recording apparatus **1**, a part of the tray guide **82** pushes the sensor **344**, so that the sensor **344** can detect the mounting of the tray guide **82**.

As is shown in FIGS. **10**A, **10**B, **12**A and **12**B, when the slide cover **81** is moved toward the main body of the recording apparatus **1**, the arms **85** interact with the slide cover **81** and are projected outward toward the main body of the recording apparatus **1**. The spur holder **43**, which holds the spur **42**, is so arranged that it is vertically displaceable regarding the platen **34**, while being urged downward by a spring force that applies a predetermined pressure. Therefore, when the arms **85** are inserted between the spur holder **43** and the platen **34**, the spur holder **43** is raised or lifted by a predetermined distance. At this time, sloping surfaces **851**, which are formed at the distal ends of the arms **85**, are employed to insert the arms **85** between the platen **34** and the spur holder **43**. Through this process, a space can be defined, between the platen **34** and the spur holder **43**, through which the tray **83** can be passed.

Before the arms **85**, which are positioned with a state where it is inserted between the platen **34** and the spur holder **43**, are projected (moved forward), they are stored, with adequate play, in the tray guide **82**. Further, since an opening **821** in the CD conveying unit **8** is closed when the slide cover **81** is not moved toward the main body of the recording apparatus **1**, the tray **83** can not be inserted. However, when the slide cover **81** is moved toward the main body of the recording apparatus **1**, the slide cover **81** is shifted obliquely upward, so that the opening **821** for the tray insertion is obtained between the slide cover **81** and the tray guide **82**. In this state, the tray **83** on which a CD is mounted can be inserted through the opening **821** and set in a predetermined position. With this configuration, if the tray **83** is inserted while the spur holder **43** is not elevated, the spur **42** can be prevented from interfering with the tray **83**, and a tray sheet **831**, at the distal end of the tray **83**, and the spur **42** can be protected from being damaged.

As is shown in FIG. **11**, when the slide cover **81** whereon the tray guide **82** is mounted is pulled out of the main body, the arms **85** interact with the slide cover **81** and are disengaged from the spur holder **43**, and the spur holder **43** and the spur **44** are lowered to their original positions. At this time, in a case the tray **83** is maintained on the slide cover **81**, the tray **83** is caught at the opening **821**, formed between the slide cover **81** and the tray guide **82**, and prevents the slide cover **81** from being pulled out farther. With this arrangement, it is possible to prevent the occurrence such a defect that, while a recording medium such as a CD-R is retained in the recording apparatus **1**, the spur **44** is lowered and damages the CD-R. Further, when the slide cover **81** is pulled out, as is shown in FIG. **11**, the slide cover **81** interacts with the hooks **84**, which are then disengaged from the guide rails **993** of the lower case **99**. As a result, the CD conveying unit **8** is released from the main body of the recording apparatus **1**.

The tray **83** used for the embodiments is a 2 to 3 mm thick resin plate. As is shown in FIG. **13**, a CD attachment portion **832**, an operating portion **833**, which is grasped by an operator when inserting or removing the tray **83**, detection marks **834** (in FIG. **13**, five marks, **834**A, **834**B, **834**C, **834**D and **834**E), which are formed, as portions to be detected, by using a highly reflective material, a CD removal hole **835**, and insertion position alignment marks **836** (two marks in FIG. **13**) are provided for the resin plate. In addition, the tray sheet **831** is attached to the distal end of the tray **83** so that the tray **83** can be securely gripped by the conveying roller **36** and the pinch roller **37**.

The detection marks **834**A is a reference position detection mark for determining the detection position of the tray **83**. The detection mark **834**B is a confirmation detection mark that, in addition to the reference position detection mark **834**A, is used to detect the position of the tray **83**. The detection marks **834**C and **834**D are reverse insertion detection marks for detecting whether the tray **83** has been inserted in a direction opposite the normal direction. The detection mark **834**E is a recording material presence/absence detection mark for determining whether a recording member has been loaded on the tray **83**.

First Embodiment

First, an explanation will be given for the structures of detection marks **834**, according to a first embodiment, that function as portions to be detected. FIG. **14** is a vertical cross-sectional view of the structure of a reference position detection mark **834**A according to the first embodiment. FIG. **15** is a plan view of a reflection plate of the reference position detection mark **834**A in FIG. **14**. FIG. **16** is a schematic vertical cross-sectional view of an example reference for the reference position detection mark **834**A. FIG. **17** is a fragmentary plan view for explaining the relative position of a sensor **59** that functions as the position detection means according to the first embodiment. FIG. **18** is a graph showing as an example a change in the light intensity during the reflection plate detection process sequence for detecting the position of a tray **83** according to the first embodiment. FIGS. **19**A, **19**B, **19**C, **19**D, **19**E and **19**F are diagrams for explaining the operation for detecting the detection marks when the

tray **83** is inserted in the normal direction. FIGS. **20**A, **20**B and **20**C are diagrams for explaining the operation for detecting the detection marks **834** when the tray **83** is inserted in the reverse direction.

FIG. **21** is a flowchart showing the detection mark detection process sequence performed by a recording apparatus **1** according to the present invention. FIG. **22** is a schematic perspective view of the state wherein the tray **83** is set into the recording apparatus **1** according to the present invention. FIG. **23** is a vertical cross-sectional view of the state wherein the tray is conveyed into the recording apparatus **1** according to the present invention. FIG. **24** is a fragmentary vertical cross-sectional view for explaining the configuration and the operation of a carriage guide shaft elevating mechanism for the recording apparatus **1** according to the invention. FIG. **25** is a schematic perspective view for explaining the actions, relative to the tray **83**, of a side pressure roller and a pressing rollers of a CD conveying unit **8** of the recording apparatus according to the invention.

In FIGS. **13** and **14**, the reference position detection mark **834**A is a portion to be detected, which is used for determining the position of the tray **83** and also as a reference for a CD printing position. The greatest accuracy is required for the detection of the reference position detection mark **834**A. This is true, because since the reference position detection mark **834**A and the position of the CD are predesignated, the positioning accuracy and the detection of the reference position detection mark **834**A directly affect the recording position accuracy. As is shown in FIG. **14**, the reference position detection mark **834**A having a reflective face **834**A**1** is fitted, from the reverse face of the tray **83**, into a recessed portion formed in the reverse face of the tray **83**. As is shown in FIG. **15**, double-sided tape **834**A**2** is attached around the reflective face **834**A**1** of the reference position detection mark **834**A to enable the adhesion of the reference position detection mark **834***a* to the tray **83**. Another method can be employed to attach the reference position detection mark **834**A to the tray **83**, and a snap fitting method or a gap filling method, for example, may be employed.

When the sensor **59** reads the position, the position is determined by using the edge of the detection mark **834**. In this embodiment, vertical faces **837** of the tray **83** are detected as the edges of the reference position detection mark **834**A. Since the vertical faces **837** are part of the tray **83**, the positioning relative to the CD attachment portion **832** can be very accurate. The reading accuracy is not affected when the reference position detection mark **834**, which is made of a different material than is the tray **83**, is slightly shifted and adhered. Furthermore, since the reflective faces **834**A**1** are present in the recessed portions in the surface of the tray **83**, the reflective faces **834**A**1** are seldom scratched. With this arrangement, a recording apparatus can be provided that has a reliable CD printing function having a very high recording accuracy.

In this embodiment, the reference position detection mark **834**A is formed by depositing aluminum on the surface of a resin (PET). The thickness of the reference position detection mark **834**A is about 0.1 to 2.0 mm, and the size is about 3 to 10 mm square. The reflectivity of the reflective faces **834**A**1** is about 50 to 98%, and inclined faces **839** are formed around the tray vertical faces **837**. Since the surfaces of the inclined faces **839** are bright finished, the light emitted by the sensor **59** provided in the carriage **50** is not returned by these inclined faces **839** to a light receiving unit. Therefore, the amount of light (the light intensity) that the light receiving unit receives from the reflective faces **834**A**1** can greatly differ, so that the accuracy with which the reflector is detected is even more increased.

The CD printing start position is located at the lower portion in the outermost circle shown in FIG. **13**, and the reference position detection mark **834**A is arranged near the CD printing start position. Therefore, after the position of the CD has been established by the reference position detection mark **834**A, the distance the tray **83** is moved to the CD printing start position is comparatively reduced. As a result, an error caused by moving the tray **83** becomes insignificant, and more accurate printing is enabled. An explanation will now be given for a difference in the reflector between an example reference and the first embodiment. In FIG. **16** showing the example reference for the tray reference position detector (reflector), a position detector **1834** on a tray **83** is a reflective face formed by hot stamping, and inclined faces **1839** are formed around the reflective face **1834**. In this example reference, when corners **1834**A**3**, which are the edges of the reflective faces **1834**, do not form complete angles, the reflective face **1834** does not become horizontal, which causes an error in the detection of the position of the reflector **1834**. Since the tray **83** is made of resin, it is actually very difficult to obtain corners **1834**A**3** that form complete angles.

On the other hand, according to this embodiment, as is shown in FIG. **14**, even if the upper and lower corners of the vertical faces **837** of the tray **83** do not form edges, the edges of the reflective face **834**A**1** can be precisely detected. While referring to FIGS. **17** and **18**, the first embodiment will be explained in further detail. FIG. **17** is a top view of the reflectors in FIGS. **14** and **16** (the same top view is applied). FIG. **18** is a graph showing the relationship between the light intensity, which is detected by the sensor **59** mounted on the carriage **50**, and the position of the sensor **59**. That is, FIG. **18** is a graph showing the results obtained by tracing the reflection plate in the direction indicated by an arrow in FIG. **17**. Generally, as is indicated at point (c) in FIG. **18**, a small amount of light reflected by the surface of the tray **83** is also detected, and as the sensor **59** moves to the positions of the inclined faces **839**, little reflected light is returned, so that the light intensity is reduced, as is indicated at point (a) in FIG. **18**.

The confirmation of the reflective face **834**A**1** is performed by a difference between the light intensities at points (a) and (b) in FIG. **18**. Since the difference in the light intensity is increased because the inclined faces **839** are provided, it is apparent that a light intensity margin for position detection can be obtained. In FIG. **14**, showing the structure of the embodiment, since the ends of the reflective face **834**A**1** are detected at points (d) and (j) in FIG. **18**, the center point (g) is the position of the reflective face **834**A, and accurate position detection can be performed. However, according to the example reference in FIG. **16**, when, for example, one of the corners **834**A**3** is rounded (R), reflective light tracing, indicated by a dashed double-dotted line (f) in FIG. **18**, is performed, so that the ends of the reflective face **1834** are detected at points (e) and (j) in FIG. **18**, and point (h) in FIG. **18** is the position of the reflective face **1834**. Therefore, for the example reference in FIG. **16**, relative to the accurate position detected in FIG. **14** for the embodiment, a distance error is caused that is equivalent to the distance indicated by X in FIG. **18**. As is described above, according to this embodiment, the possibility that this error will be caused can be eliminated.

Unlike the reference position detection mark **834**A, high position accuracy is not required for the other detection marks **834**B, **834**C, **834**D and **834**E in FIG. **13**, because these marks are detected by determining the presence or the absence of the

reflection plate. Therefore, the structure shown in FIG. **16** may be employed, or as a simpler structure, through holes may be formed in the tray **83**. So long as a difference in the reflected light can to a degree be obtained, the through holes can be employed for the detection of the presence or absence of the tray **83** (or the CD). That is, aside from the reference position detection mark **834**A, the detection marks **834**B to **834**E may be formed on the face opposite the sensor **59**.

In FIG. **13**, to position a CD that has been loaded and to remove play, a plurality of mold pawls are provided on the CD attachment portion **832**. An operator aligns the center hole of a CD with the CD attachment portion **832**, which is located one step lower than the other face of the tray **83**. The recording member presence/absence detection mark **834**E is provided on the lower face, and since this mark **834**E is exposed when no CD is mounted on the tray **83**, it can be determined that a recording member has not been mounted.

The confirmation detection mark **834**B is used to confirm the reference position detection mark **834**A. That is, in order to prevent an erroneous detection when a reflective material is attached to a CD or to the tray **83**, it can be determined that the reference position detection mark **834**A has been correctly detected, on the occasion that both the reference position detection mark **834**A and the confirmation detection mark **834**B are detected.

In FIG. **13**, the tray sheet **831** is formed at the distal end of the tray **83** so that the conveying roller **36** and the pinch roller **37** can securely grip the tray **83**. The tray sheet **831** is a sheet member having a thickness of about 0.1 to 0.3 mm, and is made, for example, of PET and has a predetermined friction coefficient and a predetermined hardness. Further, a tapered portion **830** is formed at the distal end of the tray **83**. First, a conveying force is generated by griping the tray sheet **831** between the conveying roller **36** and the pinch roller **37**, and the tapered portion **830** at the distal end of the tray **83** is raised by the pinch roller **37**. In this manner, the thick tray **83** can be held between the conveying roller **36** and the pinch roller **37** and can thus enable the conveying of the tray **83**.

In FIG. **25**, a side pressure roller is provided in the tray guide **82** of the CD conveying unit **8** to press the tray **83** against the reference face of the tray guide **82**, and the tray **83** is positioned when the tray **83** is pressed against the reference face under a predetermined pressure by a roller spring **825**. Pressing rollers **811** are provided on the right and left sides of a slide cover **812**, and when the tray **83** is pressed against the paper discharge roller **41** under a predetermined pressure by a roller spring **812**, the force for conveying the tray **83** is generated. When the printing is started, the tray **83** can be moved, by this conveying force, from the set position to the nip portion formed by the conveying roller **36** and the pinch roller **37**. Further, when the printing has been completed, the tray **83** can be moved, by the conveying force, to a predetermined position whereat the tray **83** can be extracted by the operator. In this case, the detection marks **834** and the pressure rollers **811** are arranged at different positions. Therefore, contact of the position detection marks **834** with the pressing rollers **811** is avoided and the surfaces of the position detection marks **834** are protected from being scratched. When the tray **83** conveyed to the predetermined position is pulled out, the tray **83** can be removed from the tray guide **82**.

While referring to FIGS. **19**A and **19**B to **21**, an explanation will be given for the CD printing operation and the detection mark reading sequence performed while using the above described configuration. When the CD conveying unit **8** is slid straightly toward the main body of the recording apparatus **1**, the CD conveying unit **8** is loaded into the lower case **99**. At this time, the tray guide sensor **344** can detect that the tray guide **82** has been loaded into the main body of the recording apparatus **1**. When the slide cover **81** is moved farther toward the main body of the recording apparatus **1**, the arms **85** interact with the slide cover **81** and are projected outward toward the main body. Then, the arms **85** are inserted between the spur holder **43** and the platen **34**, and raise the spur holder **43** by a predetermined distance.

In this state, when the slide cover **81** is moved toward the main body of the recording apparatus **1**, the slide cover **81** is shifted obliquely upward, and the opening **821** (FIGS. **6**A and **6**B) appears between the tray guide **82** and the slide cover **81**. At this time, as is shown in FIG. **22**, the tray **83** whereon a CD is mounted can be inserted and set at a predetermined position. Thus, the operator holds the operating portion **833** and inserts the tray **83** until the position detection marks **834** match tray set marks **826** on the tray guide **82**.

In this state, when a host transmits recording data, the recording operation is initiated. First, as is shown in FIG. **23**, the conveying roller **36** and the discharge rollers **40** and **41** are reversely rotated. Since the force for conveying the tray **83** is generated by the tray **83** being pressed against the discharge rollers **40** and **41** under a predetermined pressure by the pressing rollers **811** and the roller spring **812**, the tray **83** is conveyed into the recording apparatus **1** according to the reverse rotation of the discharge rollers **40** and **41**. When the tray sheet **831** is gripped by the conveying roller **36** and the pinch roller **37**, a predetermined conveying force is generated, and the pinch roller **37** is raised by the tapered portion **830** formed at the distal end of the tray **83**. Thus, the tray **83** is sandwiched by the conveying roller **36** and the pinch roller **37**.

Following this, the carriage **50** is moved from the home position to the recording area to detect the tray **83**. At this time, as is shown in FIGS. **24**A and **24**B, the guide shaft **52** is raised by the carriage elevating motor **58**, and an optimal gap can be formed for the tray **83**. Instead of this process, the pinch roller holder **30**, which holds the pinch roller **37**, may be actuated to separate the pinch roller from the conveying roller **36** to obtain a tray conveying space.

The process sequence performed by the sensor **59** for detecting the detection marks **834** on the tray **83** will now be described while referring to FIGS. **19**A and **19**B to **21**. FIGS. **19**A and **19**B are diagrams for explaining the operation wherein the sensor **59** traces the detection marks **834** when the tray **83** is inserted in the normal direction. FIGS. **20**A, **20**B and **20**C are diagrams for explaining the operation wherein the sensor **59** traces the detection marks **834**. FIG. **21** is a flowchart showing this detection processing. For this processing, the direction in which the carriage **50** moves is defined as the X direction, and the direction in which the tray **83** is moved is defined as the Y direction. A case wherein the tray **83** is inserted in the normal direction will initially be explained. First, in FIG. **19**A, the carriage **50** is halted at a position whereat the sensor **59** faces the reference position detection mark **834**A on the tray **83**. Then, the tray **83** is moved in the direction Y**1** shown in FIG. **19**A, and the upper edge position of the reference position detection mark **834**A is detected. Thereafter, the tray **83** is further moved in the direction Y**1**, and the lower edge of the reference position detection mark **834***a* is detected. Then, the tray **83** is moved in the direction Y**2** so that the sensor **59** is located substantially in the center of the reference position detection mark **834**A in the Y direction. Next, as is shown in FIG. **19**B, the carriage **50** is moved to the right and the left (X direction), and the right edge and the left edge of the reference position detection mark **834**A are detected.

Through the above operation, the center position of the reference position detection mark **834**A is calculated, and based on the center position, the printing position of a CD mounted on the tray **83** is obtained. Since the position of the tray **83** is detected in the above-mentioned manner, the printing on the CD does not cause the misalignment due to a variance in the accuracy of parts and the state of the tray **83**, as compared with printing performed based only on mechanical accuracy without the position detection process. Furthermore, since the CD attachment portion **832** and the edge of the reference position detection mark **834**A are provided by the same part, and since part assembly accuracy is not accumulated, high positioning accuracy can be obtained. Thereby enabling accurate CD printing.

After the position of the reference position detection mark **834**A has been detected, the carriage **50** is moved to detect the confirmation detection mark **834**B. During this movement, as is shown in FIG. **19**C, the reverse insertion detection mark **834**D is detected in order to confirm that the tray **83** has not been reversely inserted. In the Y direction, the reverse insertion detection marks **834**C and **834**D are located at the same positions, and are shifted away from the reference position detection mark **834**A. Therefore, after the reference position detection mark **834**A has been detected, and when only the carriage **50** is moved, without the tray **83** being moved in the Y direction, the reverse insertion detection mark **834**D is not detected. And when the reverse insertion mark **834**D is not detected, it is ascertained that the tray **83** has been inserted in the normal direction, not in the reverse. Following this, the carriage **50** is moved in the X direction, and the tray **83** is moved in the direction Y for the detection of the confirmation detection mark **834**B (FIG. **19**D). When the confirmation detection mark **834**B is not detected, it is ascertained that the previous detection of the reference position detection mark **834**A was not correct, and that the edge of a CD, a pattern printed on the CD or the like has been erroneously detected. Therefore, the process for detecting the reference position detection mark **834**A is performed again.

The re-detection process is repeated until the total conveyance amount of the tray **83** reaches a predetermined value. When the confirmation detection mark **834**B is detected, it is ascertained that the previous detection of the reference position detection mark **834**A was correct, and the next operation is initiated. Then, the carriage **50** is moved in the X direction, and the tray **83** is moved in the direction Y**1** for the detection of the recording member presence/absence detection mark **834**E (FIG. **19**E). When the recording member presence/absence detection mark **834**E is detected, it is ascertained that a CD has not been mounted, the printing operation is suspended, the tray **83** is discharged to a predetermined position, and a medium absence error is displayed. When a CD has been mounted on the tray **83**, as is shown in FIG. **19**F, the recording member presence/absence detection mark **834**E is not detected, so that it is ascertained that a CD has been mounted and the printing operation is continued.

While referring to FIGS. **20**A, **20**B and **20**C, an explanation will now be given for a case wherein the tray **83** is erroneously inserted in the reverse direction. As is shown in FIG. **13**, the distance in the X direction, between the reverse insertion detection mark **834**C and an end **83**B of the tray **83**, is substantially equal to the distance between the reference position detection mark **834**A and an end **83**A of the tray **83**. That is, when the tray **83** is inserted in the normal direction, the position whereat the carriage **50** is halted to face the reference position detection mark **834**A, which corresponds to the position of the reverse insertion detection mark **834**C the tray **83** is inserted in the reverse direction. When the tray **83** is inserted in the reverse direction, first, the position of the reverse insertion detection mark **834**C is detected (FIG. **20**A), and then the upper and lower ends and the right and the left ends of the reverse insertion detection mark **834**C are detected to obtain the center position of the reverse insertion detection mark **834**C. At this time, that the tray **83** has been inserted in the reverse direction cannot be detected, and it is determined that the reference position detection mark **834**A has been detected.

Following this, the carriage **50** is moved in the X direction to detect the reverse insertion detection mark **834**D (FIGS. **20**B and **20**C). As previously described, since the reverse insertion detection marks **834**C and **834**D are located at the same positions in the Y direction, the reverse insertion detection mark **834**D is detected when the tray **83** is inserted in the reverse direction. And when the reverse insertion detection mark **834**D is detected, it is ascertained that the tray **83** has been inserted in the reverse direction. When the tray **83** is inserted in the reverse direction, it is not easily advanced toward the main body of the recording apparatus **1** because the tray sheet **31** is not provided on that side. However, the tray **83** can be forcibly inserted in the reverse direction. In case of a modification of the embodiment, wherein, during the CD printing, not only the carriage **50** but also the pinch roller **37** are actuated together to perform retraction upward by a motor to obtain a paper path for the tray **83**, at the beginning of the process, it is easy to insert the tray **83** in the reverse direction. Therefore, a tray reverse insertion detection means is required.

When the reverse insertion detection marks **834**C and **834**D are not provided and the tray **83** is inserted in reverse, first, the position confirmation is performed, based on the confirmation detection mark **834**B, to detect the reference position detection mark **834**A. As a result, the confirmation detection mark **834**B is erroneously regarded as the reference position detection mark, and the printing is initiated at the incorrect position. Therefore, the reverse insertion detection marks **834**C and **834**D are required to prevent the printing of a shifted position on a CD. Further, for example, a reflection plate (detection mark) for detection of a reverse face may be provided on the reverse face of the tray **83** to detect that the tray **83** has been invertedly positioned.

After the above described series of initial processes is completed, the tray **83** is moved to a predetermined position whereat the printing of the entirety of a CD mounted thereon can be accomplished. Thereafter, the printing is begun in accordance with image data received from the host. So-called multi-path printing for forming an image by performing a plurality of scans can be employed to reduce uneven bands that occur owing to the tray conveying accuracy, the landing accuracy of ink ejected by the recording head **7**. etc. When the printing had been completed, the tray **83** is conveyed to a location whereat the operator set the tray **83** to the tray guide **82** before the printing was initiated. At this time, the operator can remove the tray **83** on which the printed CD is mounted. Further, when the operator pulls the slide cover **81**, the arms **85** are disengaged from the spur holder **43**, and the hooks **84** are disengaged from the lower case **99**. As a result, the CD conveying unit **8** can be released and removed from the main body of the recording apparatus **1**. With the above described configuration, and by employing the above described operation, there is provided a recording apparatus which can accurately print a small, thick recording member, such as a CD with a simple operation by employing a tray.

According to the above described embodiment, the recording apparatus **1** comprises: the tray conveying unit for conveying the tray **83** on which a small and thick recording

member, such as a CD, is mounted; the recording head **7**, which functions as means capable of recording on the recording member mounted on the tray, based on recording information; the to-be-detected portions **834**, which are provided on the tray **83** and are used to detect the position of the tray **83**; and the position detection means **59**, for detecting the to-be-detected portions **834** on the tray **83** to obtain the position of the tray **83**, whereby the edges of the to-be-detected portions **834** are regarded as the end faces of holes **837** formed in the tray **83**. With this arrangement, by positional detection of the tray **83** itself, the position of the tray **83** is accurately detected for recording using thick paper or a CD-R. In addition, the to-be-detected portions can be protected from being scratched, and a reliable recording apparatus that can accurately perform printing can be provided at a low cost.

Furthermore, according to this embodiment, multiple to-be-detected portions **834** are provided on the tray **83**, and at least one to-be-detected portion **834**A is formed of a reflective material. This reflective material is attached to the tray **83** from the side opposite that facing the position detection means **59**, and the reflective face **834A1** is exposed through the hole **837** in the tray **83** so as to determine the position of the tray **83** by the reflective material. Further, the to-be-detected portions **834**B to **834**E, other than the at least one to-be-detected portion **834**A, are formed in the side facing the position detection means **59**. And in addition, according to the above-mentioned embodiment, the to-be-detected portions **834**C and **834**D for detecting the reverse insertion are provided on the tray **83** to detect whether the tray **83** is inserted in a direction that differs from the normal direction. Furthermore, the to-be-detected portions **834** consist of reflective faces, which are thin plates made, for example, of aluminum.

Moreover, according to the above embodiment, the recording apparatus **1** comprises: the tray conveying means for conveying the tray **83** on which a small, thick recording member, such as a CD, is mounted; the recording head **7**, which functions as means capable of recording on the recording member mounted on the tray **83**, based on recording information; the to-be-detected portions **834**, which are formed on the tray **83** and are used to detect the position of the tray **83**; and the position detection means **59**, for detecting the to-be-detected portions **834** to obtain the position of the tray **83**, wherein the to-be-detected portions **834** include the to-be-detected portions **834**C and **834**D, for preventing a reversed insertion, that are used to detect whether the tray **83** has been inserted in a direction differing from the normal direction, and wherein the processing sequence performed by the position detection means **59**, for reading the to-be-detected portions **834**, includes a sequence for reading the to-be-detected portions **834**C and **834**D used for preventing a reversed insertion. With this arrangement, the reversed insertion of the tray **83** can be prevented, by the minimum process sequences as required, and a recording apparatus can be provided that can prevent the erroneous printing of a recording member such as a CD.

Second Embodiment

FIG. **26** is a vertical cross-sectional view of the structure of a tray position detector according to a second embodiment of the present invention. FIG. **27** is a plan view, taken from the surface of a tray, of the tray position detector in FIG. **26**. In FIGS. **26** and **27**, as in the first embodiment, the edges of a reference position detection mark **834**A are determined by vertical faces **837** formed on a tray **83**. Therefore, accurate printing can be performed for a small, thick recording member such as a CD. However, a foreign substance, such as ink mist or dust, that is attached to a reflective face **834A1** may affect the detection accuracy. So long as the substance is attached to the center of the reflective face **834A1**, it does not greatly affect the detection accuracy; however, where the substance attached near the vertical face **837**, deterioration of the edge reading accuracy would occur.

Therefore, in the second embodiment, to evacuate part of such a substance, a substance clearance (or evacuation) space **838** is formed at rear side of the vertical tray faces **837** of the reference position detection mark **834**A. That is, this embodiment has substantially the same arrangement as the first embodiment, with the exception that the clearance space **838**, for evacuating the substance thereto, is formed around the hole **837** in the tray **83** whereat the reflective face **834A1** of the reference position detection mark **834**A is exposed. A mist of ink droplets and dust tends to collect on the reflective face **834**A at the corners; however, in this embodiment, since the substance clearance space **838** is formed around the corners of the reflective face **834A1**, the possibility can be reduced that the substance will be attached immediately under the vertical faces **837**. According to the second embodiment shown in FIGS. **26** and **27**, by employing only a simple structure, the reflection plate reading accuracy can be further increased without raising the manufacturing cost, and high quality CD printing can be provided. The other configurations and the other operations performed by the embodiment, explained by referring to FIGS. **26** and **27**, are substantially the same as those for the first embodiment.

For the above two embodiments, an ink jet recording apparatus of a serial recording type has been employed that, to perform printing, moves the recording head **7** relative to the recording member. However, the present invention can also be applied for an ink jet recording apparatus of a line recording type, which performs recording only by sub-scanning using line type recording means having a length that covers all or part of the width of the recording member. In this case, the same effects can also be obtained. Furthermore, the present invention can applied for a recording apparatus that employs a single recording means, a color recording apparatus that employs a plurality of recording means, each of which has a different ink color, a gradation recording apparatus that employs a plurality of recording means for printing an image having the same color at different densities, or a recording apparatus that employs a combination of these configurations. In any case, the same effects can be obtained.

The present invention can also be applied for any arbitrary configuration of a recording head and an ink tank, e.g., a configuration employing a replaceable ink cartridge wherein a recording head and an ink tank are integrally formed or a configuration wherein a recording head and an ink tank are separately provided and are connected by an ink supply tube. In this case also, the same effects can be obtained. In addition, the present invention can be applied for an ink jet recording apparatus that employs recording means that uses an electric-mechanical conversion device such as a piezoelectric device. Above all, superior effects can be provided by an ink jet recording apparatus that employs recording means for which thermal energy is used to eject ink, because both the recording density and the resolution can be increased.

This application claims priority from Japanese Patent Application No. 2003-296195 filed Aug. 20, 2003, which is hereby incorporated by reference herein.

What is claimed is:

1. A recording apparatus, which conveys a tray provided with an attachment portion for mounting a recording medium,

and which permits a recording head to perform recording on the recording medium mounted on the tray, said apparatus comprising:

a detection mark provided with the tray;

a carriage for moving the recording head, said carriage mounting the recording head thereon; and

a sensor, arranged to said carriage, for sensing a position of the detection mark to detect a position of the recording medium mounted on the tray,

wherein the detection mark comprises a reflection member, the reflection member is fixed to the tray from a reverse side of a face of the tray opposite to the sensor, and a reflection face of the reflection member is exposed from a hole portion formed in the tray.

2. A recording apparatus according to claim **1**, wherein the tray includes a plurality of detection marks, wherein at least one of the detection marks is formed of a reflective material, and wherein the reflective material is attached from a side opposite to a side facing the sensor, and a reflective face of the reflective member is exposed through the hole portion of the tray.

3. A recording apparatus according to claim **2**, wherein a plurality of detection marks other than the at least one detection mark are attached to the side facing the position detector.

4. A recording apparatus according to claim **2**, wherein a clearance space capable of evacuating foreign material is formed around the hole portion in the tray on which the reflective face of the reflective member is exposed.

5. A recording apparatus according to claim **1**, wherein the tray has a detector for detecting whether the tray has been reversely inserted.

6. A recording apparatus according to claim **1**, wherein the detection mark has reflective faces comprising thin plates made of aluminum.

7. A tray, comprising:

an attachment portion for mounting a recording medium; and

a detection mark which is to be detected by a sensor arranged to a carriage for mounting a recording head,

wherein the detection mark comprises a reflection member, the reflection member is fixed to the tray from a reverse side of a face opposite to the sensor, and a reflection face of the reflection member is exposed from a hole portion formed in the tray.

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